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AMMONIA TOXICITY
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WATER DIVISION
U.S. ENVIRONMENTAL PROTECTION AGENCY
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ABSTRACT

Several authors have reported that the harmful effects of ammonia are primarily related to the pH and temperature of the water because only the un-ionized ammonia is toxic. The un-ionized fraction increases with rising pH values and with rising temperature.

Other factors such as dissolved oxygen, alkalinity, free carbon dioxide, sodium ions, total dissolved solids, prior exposure to ammonia, physical stress, general physiological status, and the presence of other additive toxins or other mitigating parameters will have a great effect on the overall toxicity of ammonia to aquatic organisms.

The actual reported toxic concentrations of ammonia vary from 0.16 mg/l to 16.5 mg/l $\text{NH}_3\text{-N}$. This apparent variability often resulted from the investigator's failure to report pH and temperature values as well as other factors which may have biased their results. It appears that the highest concentration of un-ionized ammonia which apparently will not cause any adverse effects is 0.02 mg/l $\text{NH}_3\text{-N}$.

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INTRODUCTION

This document summarizes some of the present knowledge on the effect of ammonia on fish and establishes the maximum permissible concentration limit which shall be applicable to those waters classified for fisheries use.

Ammonia is present in most waters at varying concentrations. It appears that several of the reported high concentrations are due primarily to municipal sewage effluents and, to a lesser degree, certain industrial discharges. Some agricultural discharges, such as feedlot runoffs, may also contain high concentrations of ammonia. In some areas, especially in winter, fish rearing facilities may contribute to the total load.

Some investigators, as early as 1913, observed that the toxic effect of ammonia could be related to the pH of a solution. It was not until 1947 that Wuhrmann, et al. (1947) demonstrated that it was the un-ionized ammonia that was the toxic agent and that the ionized ammonia had very little or no toxic effect. Table I summarizes some of the un-ionized ammonia toxicity data reported in the literature.

The terms ammonia, ammonium, ionized and un-ionized ammonia have been a point of confusion within the literature. Lloyd and Herbert (1960) indicated that for purposes of clarity and uniformity, the terms "ionized ammonia" (NH_4^+) and "un-ionized ammonia" (NH_3) should be adopted to describe the two forms of ammonia and that "ammonia" would include both forms ($\text{NH}_4^+ + \text{NH}_3$). These terms will be used in this document. Reported toxic values for ammonia either as ionized or un-ionized, are normally expressed as either mg/l NH_3 or mg/l $\text{NH}_3\text{-N}$. To be consistent with the current method of reporting ammonia, concentrations of un-ionized and ionized ammonia as well as ammonia will be expressed as mg/l $\text{NH}_3\text{-N}$.

Table I. Summary of Toxicity Data

<u>Organism</u>	<u>Toxicity mg/l as N Un-ionized Ammonia</u>	<u>Source</u>
Trout spawn	0.25-0.33 LC ₅₀	Wuhrmann and Woker (1948)
Brown trout fry	0.33 10 hr. LC ₆₀	Penaz (1965)
Rainbow trout	0.4 LC ₅₀	Lloyd and Herbert (1960)
Rainbow trout	1.5 LC ₅₀	Merkens and Downing (1957)
Rainbow trout	0.4 24 hr. LC ₅₀	Ball (1967)
Rainbow trout	0.5 LC ₅₀	Herbert and Shurben (1963)
Rainbow trout	0.4-0.58 24 hr. LC ₅₀	Herbert and Shurben (1965)
Rainbow trout	0.39 24 hr. LC ₅₀	Lloyd and Orr (1969)
Rainbow trout	0.16 24 hr. LC ₅₀	Liebmann (1960)
Rainbow trout	0.18 48 hr. LC ₁₅	Ball (1967)
Rainbow trout	0.09 48 hr. LC ₅	Ball (1967)
Rainbow trout	0.55 44 hr. LC ₅	Ball (1967)
Rainbow trout	6 weeks exposure to 0.005 caused gill hyperplasia	Burrows (1964)
Atlantic salmon smolt	0.23 24 hr. LC ₅₀	Herbert and Shurben (1965)
Roach	0.35 96 hr. LC ₅₀	Ball (1968)
Rudd	0.36 96 hr. LC ₅₀	Ball (1968)
Bream	0.4 96 hr. LC ₅₀	Ball (1968)
Perch	0.29 96 hr. LC ₅₀	Ball (1968)
Common carp	0.74-1.1 10-day LC ₁₇	Ball (1968)
Common carp	0.09 35-day LC ₈	Flis (1968)
Gold fish	1.6-2.0 LC ₁₀₀	McKee & Wolf (1963)
Brook trout	2.5 24 hr. LC ₁₀₀	McKee & Wolf (1963)

Table I. Summary of Toxicity Data

<u>Organism</u>	<u>Toxicity mg/l as N</u> <u>Un-ionized Ammonia</u>	<u>Source</u>
Carp, Shiner	4.0 LC ₁₀₀	McKee & Wolf (1963)
Suckers, Trout	4.0 LC ₁₀₀	McKee & Wolf (1963)
Creek chub	4.0 24 hr. LC , 15-21C	McKee & Wolf (1963)
Suckers, Shiner, Carp	5.2 24 hr LC ₁₀₀	McKee & Wolf (1963)
Bluegill, Sunfish	6.0 48 hr. LC ₅₀	McKee & Wolf (1963)
Fathead minnows	7.0 48 hr. LC ₅₀	McKee & Wolf (1963)
Bluegill, Sunfish	7.4 48 hr. LC ₅₀	McKee & Wolf (1963)
Sucker, Shiner, Carp	8.0 15 min. LC ₁₀₀	McKee & Wolf (1963)
Small fish	12.0 24 hr. LC ₁₀₀	McKee & Wolf (1963)
Creek chub	12.0 24 hr. LC ₁₀₀	McKee & Wolf (1963)
Perch	12.0 LC ₁₀₀	McKee & Wolf (1963)
Mosquitofish	14.8 96 hr. LC ₅₀	McKee & Wolf (1963)

From a review of the literature regarding the toxicity of ammonia to aquatic biota, the European Inland Fisheries Advisory Commission (1970) concluded that it was unlikely that concentrations lower than those adversely affecting fish would be toxic to other organisms. Therefore, it appears that fish will be the critical organisms when establishing an in-stream limitation and although it may appear that different species of fish exhibit dissimilar susceptibilities to un-ionized ammonia, such is not the case. Trout and carp are equally susceptible to un-ionized ammonia given time to react; although time-based responses are different, the ultimate response to a given concentration of un-ionized ammonia is the same (Ball, 1967).

Personal communications from Drs. Donald I. Mount and William A. Brungs, National Water Quality Laboratory, Duluth, indicate that the, as yet unpublished, U. S. Environmental Protection Agency's "Criteria for Water Quality" recommends that, for freshwater aquatic life, un-ionized ammonia not exceed 0.025 mg/l as NH_3 (0.02 mg/l $\text{NH}_3\text{-N}$). The European Inland Fisheries Advisory Commission (EIFAC) has recommended the same concentration for their inland fisheries. These recommendations have been supported by the National Water Quality Laboratory, Duluth.

CRITICAL VARIABLES AFFECTING AMMONIA TOXICITY

pH Values

Several investigators have reported values for toxic concentrations of ammonia which appear to be at variance. Wuhrmann and Woker (1948) demonstrated that it was the un-ionized ammonia molecule that was the toxic agent and that as the pH of the solution increased, the fraction of un-ionized ammonia increased correspondingly. Later studies by Downing and Merkens (1955) confirmed that the toxicity of ammonia could be directly related to the concentration of un-ionized ammonia present and that the apparent discrepancies which had appeared in some earlier reports were not at variance, but could be compatible when adjusted to concentrations of un-ionized ammonia. In more recent work, Tabata (1962) found that the ionized ammonia fraction could be toxic. He concluded, however, that it was only one-fiftieth as toxic as the un-ionized fraction. Tabata's conclusion is at variance with that of Downing and Merkens who indicated that only the un-ionized fraction was toxic.

Temperature

Generally, the toxicity of ammonia decreases with lower temperatures, due mainly to decreasing fractions of un-ionized ammonia present. However, in addition to its affect on the dissociation of ammonia, temperature extremes also have a demonstrated affect on the performance, survival and toxicant susceptibility of fish. This effect was borne out by studies done by Woker (1949). He demonstrated that, although the survival time of chub (Squalius cephalus) at constant levels of un-ionized ammonia decreased with rising temperatures, the LC₅₀ remained constant. Burrows (1964), in his observations of the toxicity of ammonia to hatchery reared salmonids, demonstrated that the mitigating affects of lower temperatures may hold true only to about 10 C. Burrows reported that un-ionized ammonia was more toxic to chinook salmon below 10 C. Work done by Brown (1969) suggests that at 3 C, the LC₅₀ of un-ionized ammonia for rainbow trout is about half that found at 10 C. It appears, therefore, that the affect which temperature has on the dissociation of ammonia could be negated by the stress induced by lower critical temperatures. The EIFAC (1970) has indicated that for temperatures below 5 C, the maximum permissible concentration of un-ionized ammonia may be less than 0.02 mg/l NH₃-N.

Figure 1 demonstrates the affect which temperature and pH have on the dissociation of ammonia. For practical purposes, the method for calculating the percentages of un-ionized ammonia as suggested by the European Inland Fisheries Advisory Commission (1970) will be used as shown in Table II.

Figure 1. Percentage of Un-ionized Ammonia in Ammonia-Water Solutions at Various pH and Temperature Values

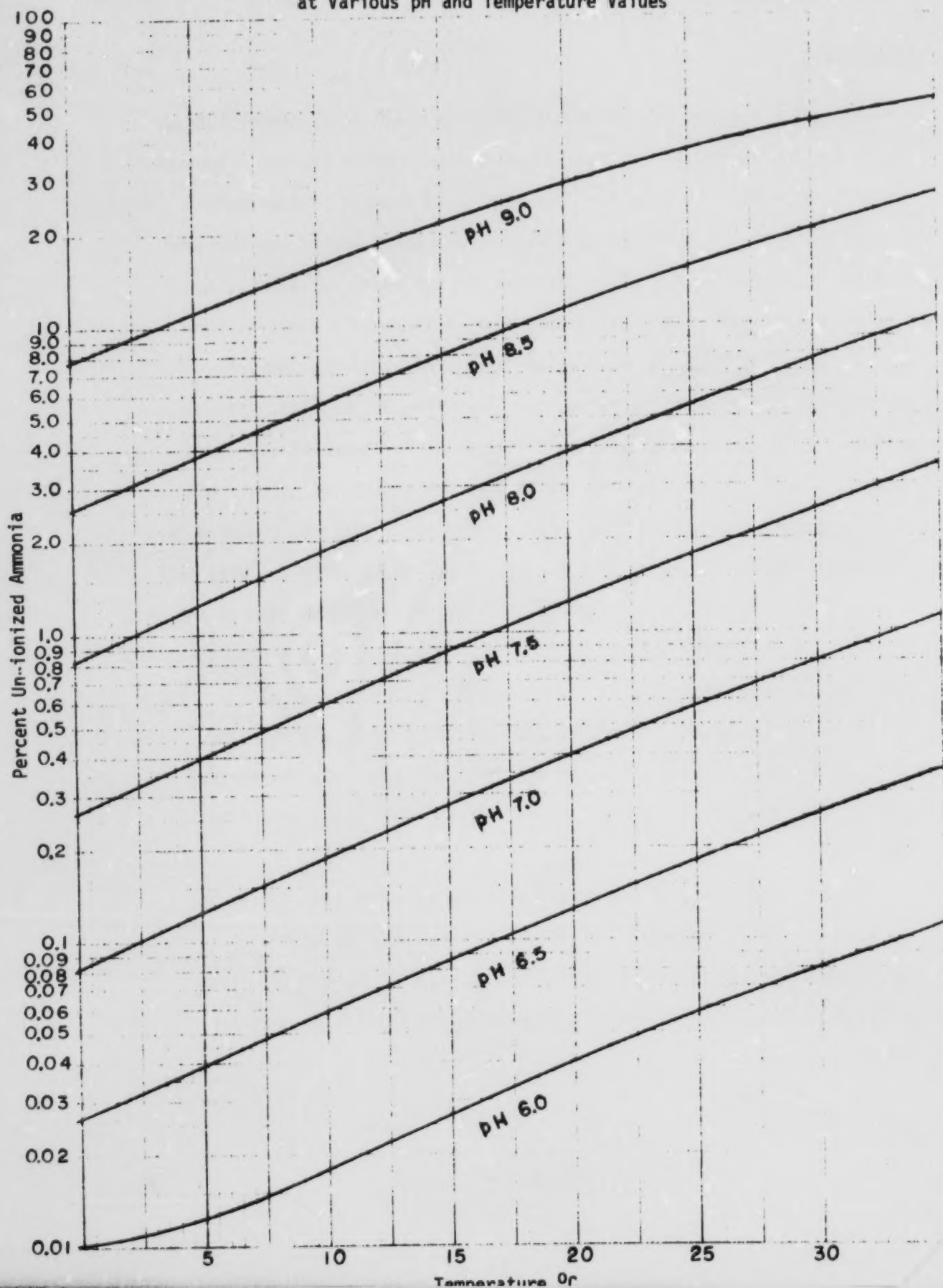
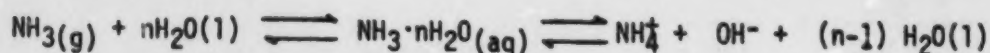


Table II. Method for calculating the percentages of un-ionized ammonia present in ammonia-water solutions.

In ammonia-water solutions, un-ionized ammonia exists in equilibrium with the ammonium ion and hydroxide ion. Butler (1964) shows the equation expressing this equilibrium as:



Derivation formula:
$$\frac{(\text{NH}_4^+) (\text{OH}^-)}{(\text{NH}_3 \cdot \text{H}_2\text{O})} = K_b$$

Temperature °C	<u>pk_w(a)</u>	<u>pk_b(b)</u>	<u>pk_a(c)</u>
0	14.944	4.862	10.082
5	14.734	4.830	9.904
10	14.535	4.804	9.731
15	14.346	4.782	9.564
20	14.167	4.767	9.400
25	13.997	4.751	9.246
30	13.833	4.740	9.093
35	13.680	4.733	8.947

(a) pK_w values from the Handbook of Chemistry and Physics 50th edition, 1969, page D-120. The Chemical Rubber Company.

(b) R.G. Bates and G.D. Pinching, J. Am. Chem. Soc., 1950, 72:1393.

(c) Bates and Pinching (1949) critically evaluated the constants for the dissociation of the ammonium ion at five-degree intervals from 0 to 50 C. In determining the constants at intermediate temperatures, the temperature dependence of the pK values must be established. In a recent excellent analysis of the literature data on the ammonia-water equilibrium system, Thurston, Russo, and Emerson (1974) devised such a calculated coefficient utilizing computer techniques which statistically represent a completely adequate fit to the Bates and Pinching data. Thurston, Russo and Emerson have suggested the following equation to calculate pK_a at all temperatures, in ammonia-water solutions of zero salinity:

$$pK_a = 0.09018 + 2729.92/T$$

$$\text{Where } T = ^\circ\text{C} + 273.2$$

This equation has been used in this document.

$$(1) \frac{(\text{NH}_4^+) (\text{OH}^-)}{(\text{NH}_3 \cdot \text{H}_2\text{O})} = K_b, \text{ where } K_b \text{ is the dissociation constant for ammonia}$$

$$(2) \frac{(\text{NH}_4^+)}{(\text{NH}_3 \cdot \text{H}_2\text{O})} = \frac{K_b}{(\text{OH}^-)}$$

$$(3) (\text{NH}_4^+) = \frac{K_b}{(\text{OH}^-)} (\text{NH}_3 \cdot \text{H}_2\text{O})$$

$$(4) (\text{NH}_4^+) + (\text{NH}_3 \cdot \text{H}_2\text{O}) = \text{ammonia}$$

$$(5) \text{ Substituting the value for } (\text{NH}_4^+) \text{ from equation (3) into equation (4),}$$

$$\frac{K_b (\text{NH}_3 \cdot \text{H}_2\text{O})}{(\text{OH}^-)} + (\text{NH}_3 \cdot \text{H}_2\text{O}) = \text{ammonia}$$

$$(6) \text{ By factoring out } (\text{NH}_3 \cdot \text{H}_2\text{O})$$

$$\text{NH}_3 \cdot \text{H}_2\text{O} \left(1 + \frac{K_b}{(\text{OH}^-)}\right) = \text{ammonia}$$

$$(7) \frac{\text{NH}_3 \cdot \text{H}_2\text{O} \times 100}{\text{ammonia}} = \frac{100}{1 + \frac{K_b}{(\text{OH}^-)}} = \text{Percent un-ionized ammonia}$$

$$(a) K_w = K_a K_b$$

$$(b) K_b = \frac{K_w}{K_a}$$

$$(c) \frac{K_b}{(\text{OH}^-)} = \frac{K_w}{K_a (\text{OH}^-)} = \frac{(\text{OH}^-) (\text{H}^+)}{K_a (\text{OH}^-)} = \frac{(\text{H}^+)}{K_a} = \text{antilog} (pK_a - pH)$$

$$(8) \text{ Percent un-ionized ammonia} = \frac{100}{1 + \text{antilog} (pK_a - pH)}$$

Given a maximum permissible in-stream concentration of un-ionized ammonia of 0.02 mg/l $\text{NH}_3\text{-N}$,

$$(9) \quad \text{Then, } \frac{0.02 \text{ mg/l } \text{NH}_3\text{-N} \times 100}{\text{percent un-ionized ammonia}} = \text{ammonia - N}$$

Total Dissolved Solids - Salinity

Herbert and Shurben (1965) reported that, under experimentally controlled conditions of constant pH, the LC_{50} 's of ammonia to rainbow trout in solutions nearly isotonic with fish blood (.9%) were approximately twice those observed in freshwater (.05%). Thurston, Russo and Emerson (1974) indicate that an increase in solution ionic strength results in a concomitant decrease in the un-ionized ammonia fraction of ammonia. This, in part, could rationalize that data reported by Herbert and Shurben. However, further work is needed to clarify the observed mitigating affects of total dissolved solids.

Free Carbon Dioxide

Lloyd and Herbert (1960) showed that the toxicity of ammonia is not entirely dependent on the pH value of the bulk of the solution, but on that of the water at the gill surface. Lloyd (1961) indicated that this value can be readily calculated from the bicarbonate alkalinity, temperature, and free carbon dioxide concentration in the water, and the free carbon dioxide excreted by the gills of the fish. He estimated the concentration of excreted carbon dioxide in the respired water (as mg. carbon dioxide/liter) by using the formula,

$$\text{D.O.} \times \text{R.Q.} \times \frac{\text{mol. wt. CO}_2}{\text{mol. wt. O}_2} \times \frac{P}{100},$$

where D.O. is the dissolved oxygen concentration of the water in

mg/l, R.Q. the respiratory quotient of the fish (assumed to be 0.8), and P the percentage removal of oxygen from the respired water. Lloyd (1961) stated that "as the oxygen concentration of the water is reduced, the concentration of excreted carbon dioxide at the gill surface is also reduced and the pH value of the water at this surface rises, resulting in an apparent increase in the toxicity of ammonia. This increase in toxicity will become greater as the concentration of free carbon dioxide in the bulk of the solution is reduced." However EIFAC (1970) points out that under conditions where dissolved oxygen concentrations are adequate, free carbon dioxide levels very low and pH values high, the level of un-ionized ammonia which is toxic to fish may be about five times greater than those indicated for polluted waters where free carbon dioxide is high and pH lower. This manifest reduction in toxicity is possibly due to an increased pressure gradient across the respiratory membrane, which would facilitate the rapid excretion of carbon dioxide.

Dissolved Oxygen

Several investigators have found that lower concentrations of dissolved oxygen can greatly affect the toxicity of several toxins. Downing and Merkens (1955) and Lloyd (1961) found this effect to be quite evident with ammonia. Lloyd felt that a reduction in dissolved oxygen concentration would be accompanied by an increased rate in ventilation by fish. This could then increase the toxicity of ammonia in two ways. First, the increased rate of ventilation would effect a greater rate of exposure to the un-ionized ammonia molecule. Secondly, increased respiration would effectively reduce the concentration of

carbon dioxide being excreted at the gill surface, thereby increasing the pH at that surface. The effects of varying concentrations of both dissolved oxygen and carbon dioxide are obviously related.

Bicarbonate Alkalinity

The most pronounced effect which bicarbonate alkalinity has on the toxicity of ammonia is associated with the affect which it has on the pH of the solution in conjunction with the concentration of free carbon dioxide present. This effect has been demonstrated by Lloyd (1961).

Prior Exposure

Lloyd and Orr (1969) demonstrated that rainbow trout exposed to sub-lethal concentrations of ammonia could then be exposed to lethal concentrations with no apparent harm. This ability to acclimate was retained for about one day but was lost after about three days. However, no estimates of the maximum concentration in which a fish could survive were given.

TOXICITY OF AMMONIA IN THE PRESENCE OF OTHER POISONS

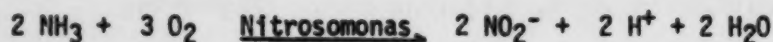
The European Inland Fisheries Advisory Commission's "Report on Ammonia and Inland Fisheries" (1970) states that "several tests have been made with rainbow trout on the toxicity of mixtures of ammonia with other poisons. Experiments with solutions containing both ammonia and cyanide showed that the combination was more toxic than either substance alone (Wuhrmann and Woker, 1948). Herbert (1962) showed that the threshold LC₅₀ of a mixture of ammonia and phenol was obtained when the sum of the individual concentrations, expressed as the proportion of their separate threshold LC₅₀ values, equalled unity. Further tests with zinc and ammonia (Herbert and Shurben, 1964), and copper and ammonia (Herbert and Van Dyke, 1964) gave similar results, in that the toxicity of the individual poisons could be added together in this manner." However, Brown, Jordan and Tiller (1969) showed that mixtures of zinc, phenol, and ammonia, in which the proportion of the total toxicity contributed by zinc was predominate, were significantly less toxic than the expected values. It may be possible that this method of summing toxicities is not valid for all concentrations of poisons.

Vamos and Tasnadi (1967) reported using copper sulfate to reduce the toxicity of ammonia in carp ponds. It was suggested that, on a short exposure basis, the copper-ammonia compounds formed were not toxic, a finding opposite to that of Herbert and Van Dyke (1964) in laboratory experiments. It is possible, then, that in situ bioassays will have to be conducted to arrive at a more valid acceptable ammonia concentration for a particular situation, especially when other additive toxins are present in relatively high concentrations.

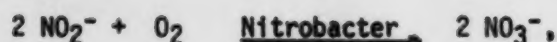
OTHER EFFECTS OF AMMONIA

Indirectly, ammonia can have adverse impacts on fish. Ammonia, either ionized or un-ionized can have a direct influence on the dissolved oxygen concentrations of water.

Under aerobic conditions, ammonia is readily oxidized to nitrite by Nitrosomonas bacteria. Nitrite can be, in turn, oxidized to nitrates by Nitrobacter. Sawyer and McCarty (1967) show the reactions,



and



whereby 2 moles of ammonia will consume 4 moles of oxygen. Ammonia, then, could theoretically have an ultimate oxygen demand of 4.57 mg O₂/mg NH₃-N.

Nitrates, as such, may act to increase the net productivity of aquatic systems. To a certain extent this may be quite beneficial to the entire aquatic community. However, when nitrate levels become excessive, and assuming that the other nutrient factors are present, eutrophication and associated algal blooms can become a severe problem.

MECHANISM OF TOXIC ACTION

Fromm (1970) noted that rainbow trout excrete ninety-four percent of their total nitrogen as ammonia, urea and protein nitrogen. Ammonia is produced endogenously by fish primarily via the degradation of protein, more specifically the deamination of various amino acids. Most authors indicate that teleost fish, unlike mammals, synthesize urea via the purine pathway. Prosser and Brown (1961) indicate that pyrimidine nucleic acids are generally excreted as either ammonia or urea by teleosts.

Of those possible nitrogenous excretory products, ammonia is the smallest and simplest. It is extremely soluble in water and is, normally, easily excreted by fish across the lipid soluble cell membranes of the gills. Except for the toxicity of ammonia, there are advantages over urea as the chief product of nitrogen metabolism. The conversion of protein nitrogen to ammonia requires substantially less energy than urea production. Actually, some deamination reactions lead to the production and capture of free energy (Figure 2).

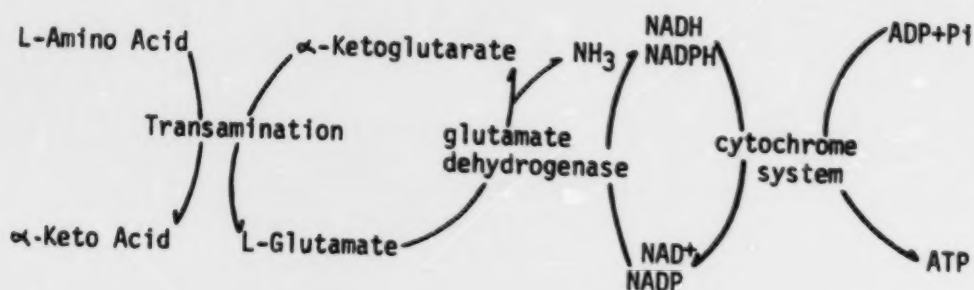


Figure 2. Deamination of amino acids and production of ATP via coupled transamination of glutamate dehydrogenase. (Forster and Goldstein, 1969)

Mammals normally synthesize urea via the ornithine urea cycle (Forster and Goldstein, 1969). However, teleost fish lack two enzymes involved in the first two steps of the ornithine cycle, carbamyl phosphate synthetase and ornithine transcarbamylase. Forster and Goldstein (1969) indicate that urea is probably synthesized from purines and, in some instances, from amino acids by teleosts (Figure 3).

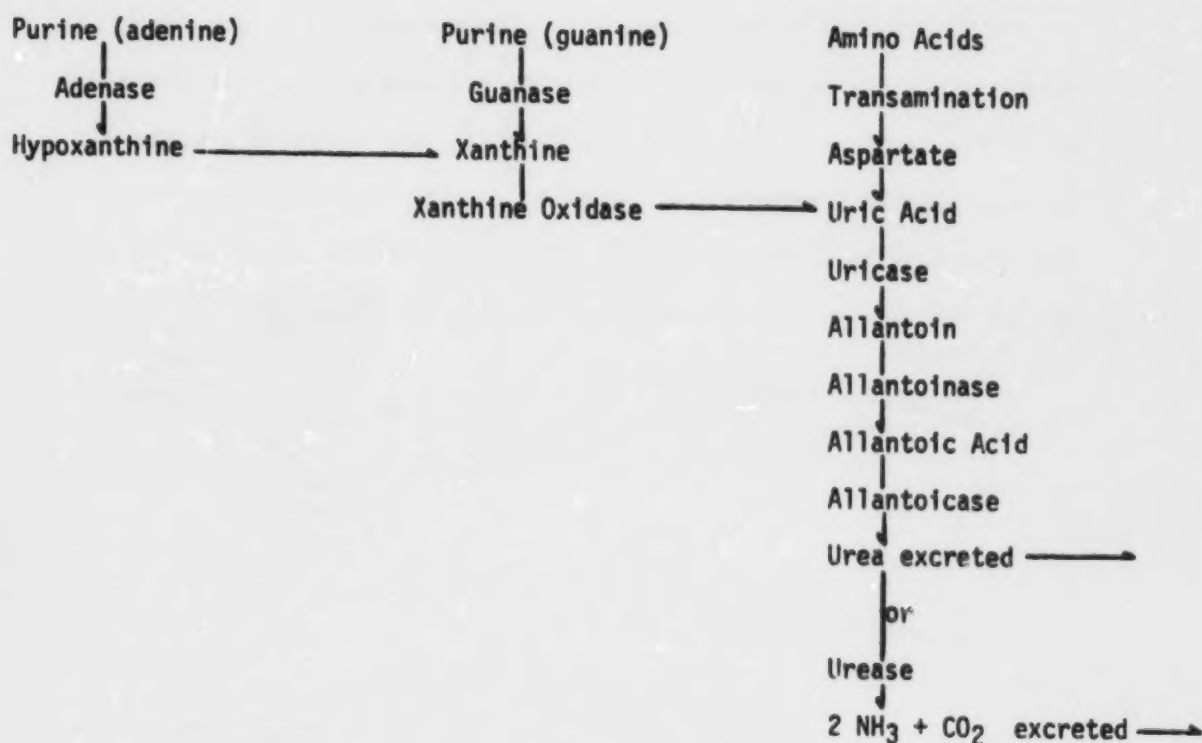


Figure 3. Urea and ammonia production via and purine pathway. (modified from Forster and Goldstein, 1969 and Prosser and Brown, 1961)

Ammonia is a toxic substance. An animal must either excrete it or detoxify it. Most fish, because of their aqueous environment will excrete ammonia rather than detoxify it. Some authors feel that teleost fish are obligated to excrete ammonia rather than detoxify it because they lack the specific enzymes necessary for this process (Forster and Goldstein, 1969).

The excretion of ammonia is extremely dependent upon the pH of both the plasma fluid and water at the gill surface. Normally, only un-ionized ammonia (NH₃) is excreted through the lipid soluble membrane. At the pH of body fluids less than one percent of the ammonia exists as un-ionized ammonia but the conversion of NH₄⁺ to NH₃ is instantaneous and hence probably not a rate limiting step in its elimination (Forster and Goldstein, 1969).

Although NH_4^+ probably does not passively diffuse across the gill membrane, it may be possible for NH_4^+ to exchange with Na^+ in the water by cation exchange. Confirmation of the $\text{Na}^+/\text{NH}_4^+$ exchange process was obtained in the freshwater eel where it was shown that injections of ammonium sulfate increased sodium influx sixfold without effecting sodium efflux (Forster and Goldstein, 1969) as shown in Figure 4.

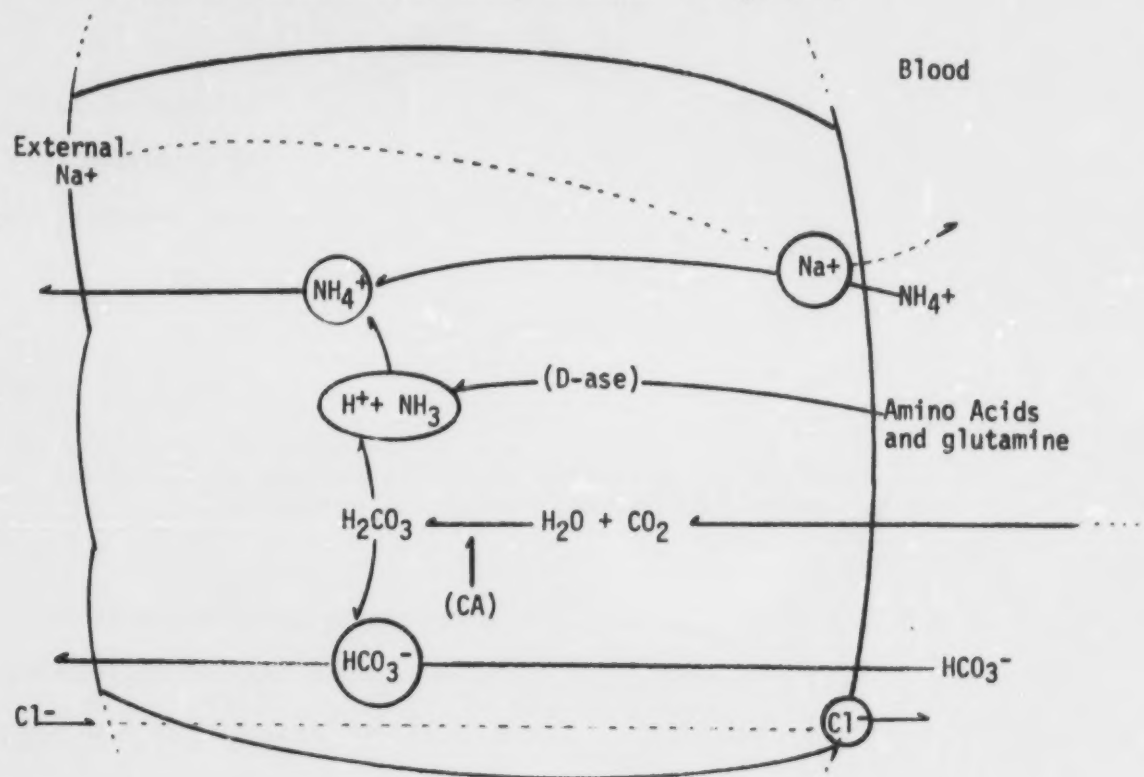


Figure 4. - Schematic representation of ionic exchanges in brachial cells. Deamination and deamination enzymes (D-ase) and carbonic anhydrase (CA). (Forster and Goldstein, 1969)

Fromm (1970) indicated that un-ionized ammonia in water at 1.0 mg/l-N is toxic to trout because it prevents the excretion of normal amounts of ammonia. The toxic action most probably is cytologic, and the nervous system appears to be affected earliest. Contrary to what other investigators have reported, Fromm felt that un-ionized ammonia at 1.0 mg/l-N does not appear

to kill fish by preventing exchange of the respiratory gases at the gill surface or by inhibiting transport of oxygen in combination with hemoglobin.

Studies conducted by Burrows (1964) indicate that continuous exposure to low levels of un-ionized ammonia greatly affected the physiology of salmonids. He noted that exposure to as little as 0.3 mg/l ammonia-NH₄ (0.002 mg/l un-ionized ammonia as N) for six weeks greatly reduced the stamina, performance and growth of salmon. Histological examination of the gill lamella showed extensive hyperplasia of the gill epithelium. Similar examinations of salmon exposed to 0.70 mg/l ammonia-NH₄ (0.005 mg/l un-ionized ammonia as N) for six weeks showed even more extensive hyperplasia, to the extent that there was fusion of the lamella. Obviously, this pathological condition could effectively reduce the surface area of the gills for gas exchange, which would explain the effected physiology. Burrows indicated that this condition would make the fish highly susceptible to gill infections, a problem common to fish rearing units.

Burrows noted that the principal nitrogenous excretory product was greatly dependent upon age, sex, species and stress placed upon fish. Under low loading conditions in the raceways, as well as at night under average loading rates, urea was the primary nitrogenous excretory product. Under higher loading rates and during periods of daylight activity, ammonia became the primary nitrogenous excretory product. Burrows did not offer an explanation for urea suppression, but it appears likely when salmonids are stressed, from either increased physical activity or high hatchery loading rates, they would tend to conserve as much energy as possible and since, as pointed out earlier, urea synthesis requires substantially more energy than ammonia synthesis, the production of ammonia would be favored.

CONCLUSIONS AND RECOMMENDATIONS

1. The effect of ammonia on inland fisheries is an important factor to be considered when establishing water quality criteria. The presence of ammonia is due primarily to municipal sewage effluents and, to a lesser degree, certain industrial discharges. Certain agricultural discharges, such as feedlot runoffs, may also contain high concentrations of ammonia.

2. The mechanism of toxicity of un-ionized ammonia is highly debatable and should be investigated further. It appears likely to be twofold, depending on the concentration. High concentrations appear to limit the excretion of metabolic ammonia, inducing hyperammonemia and subsequent histologic insult. Continuous exposure to low levels induce histopathologic aberrations of gill epithelia, stressing the animal and making it less resistant to subsequent pathological conditions.

3. Many factors such as pH, temperature, alkalinity, dissolved oxygen, free carbon dioxide, sodium ions, total dissolved solids, presence of other toxins and other factors will greatly affect the toxicity of ammonia. Once a 96-hour LC_{50} has been determined using the receiving water in question and the most sensitive species, in the most sensitive portion of its life cycle in the locality as the test organisms, a concentration of un-ionized ammonia safe to aquatic life in that water can be estimated by multiplying the 96-hour LC_{50} by a determined application factor; but, in general, the maximum permissible in-stream concentration of un-ionized ammonia should be 0.02 mg/l NH_3-N for waters classified for fisheries use.

Table III shows the calculated values, based on pH and temperature, for ammonia as N which would give an un-ionized ammonia concentration of 0.02 mg/l NH_3-N . Further, more extensive values are given in Appendix A.

Table III. Concentrations of ammonia ($\text{NH}_4^+ + \text{NH}_3$) which contain an un-ionized ammonia concentration of 0.02 mg/l $\text{NH}_3\text{-N}$.

<u>Temperature</u>	<u>pH Value</u>						
	6.0	6.5	7.0	7.5	8.0	8.5	9.0*
5	165	52.3	16.6	5.25	1.67	.543	.186
10	111	35.1	11.1	3.53	1.13	.371	.131
15	75.5	23.9	7.57	2.41	.775	.259	.0961
20	51.0	16.5	5.22	1.67	.541	.185	.0726
25	36.3	11.5	3.65	1.17	.384	.135	.0569
30	25.7	8.13	2.58	.832	.277	.102	.0462

*The European Inland Fisheries Advisory Commission (EIFAC), reports that criteria under this heading may be unduly low if there is little free carbon dioxide in the water.

The range of limitations for ammonia are based on pH and temperature variations and assume an activity coefficient of 1.0. For example, at a pH of 7.5 and a temperature of 15 C, the maximum permissible ammonia concentration is 2.41 mg/l as N. This concentration of ammonia would produce an un-ionized ammonia concentration of 0.02 mg/l $\text{NH}_3\text{-N}$. Concentrations of maximum permissible ammonia for pH and temperature values outside of those in Table III are not necessarily valid for reasons explained in the text of this document.

APPENDIX A

**Calculations of Percentages of Ionized
and Un-ionized Ammonia in Ammonia-Water Solutions**

TIME	PH	DO	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ ⁺ NH ₃
0.0	9.1	10.426	120936.44	0.00027	99.99973	2440.15312
0.1	9.1	10.3826	46365.37	0.00104	99.99896	1978.00586
0.2	9.1	10.526	76307.44	0.001310	99.99869	1571.19067
0.3	9.1	10.826	6813.27	0.001656	99.99834	1246.04761
0.4	9.1	10.826	44186.40	0.002077	99.99792	991.365234
0.5	9.1	10.826	36244.50	0.002617	99.99738	787.474609
0.6	9.1	10.826	30376.73	0.003242	99.99676	625.518311
0.7	9.1	10.826	24130.72	0.004144	99.99586	496.871426
0.8	9.1	10.826	19167.74	0.005217	99.99478	394.644326
0.9	9.1	10.826	15227.50	0.006567	99.99343	313.513428
1.0	9.1	10.826	12044.05	0.008264	99.99174	249.037064
1.1	9.1	10.826	9805.84	0.010403	99.98959	197.421701
1.2	9.1	10.826	7630.65	0.013103	99.98689	157.13771
1.3	9.1	10.826	6061.41	0.016443	99.98356	124.424997
1.4	9.1	10.826	4814.76	0.020763	99.97923	99.156448
1.5	9.1	10.826	3824.50	0.026140	99.97386	78.767090
1.6	9.1	10.826	3037.91	0.032906	99.96703	62.571243
1.7	9.1	10.826	2413.10	0.04123	99.95877	49.706421
1.8	9.1	10.826	1916.80	0.052143	99.94785	39.487503
1.9	9.1	10.826	1522.57	0.065635	99.93437	31.70285
2.0	9.1	10.826	1204.42	0.082610	99.91737	24.422577
2.1	9.1	10.826	980.58	0.103985	99.89601	18.800964
2.2	9.1	10.826	763.19	0.130474	99.86953	15.32729
2.3	9.1	10.826	606.15	0.164704	99.83529	12.501204
2.4	9.1	10.826	481.44	0.207262	99.79274	9.934306
2.5	9.1	10.826	382.44	0.260745	99.73912	7.895350
2.6	9.1	10.826	303.80	0.328089	99.67190	6.275737
2.7	9.1	10.826	241.31	0.412683	99.58731	4.984237
2.8	9.1	10.826	191.63	0.514984	99.48503	3.967332
2.9	9.1	10.826	152.26	0.632493	99.36750	3.155402
3.0	9.1	10.826	120.94	0.780050	99.21994	2.510423
3.1	9.1	10.826	98.07	1.030142	98.96983	1.998655
3.2	9.1	10.826	76.31	1.283483	98.70652	1.591825
3.3	9.1	10.826	60.62	1.622941	98.37702	1.264664
3.4	9.1	10.826	48.15	2.034634	97.96536	1.011975
3.5	9.1	10.826	38.25	2.544027	97.451965	0.808077
3.6	9.1	10.826	30.38	3.186747	96.813248	0.646113
3.7	9.1	10.826	24.13	3.979036	96.020950	0.517461
3.8	9.1	10.826	19.17	4.958222	95.041763	0.415270
3.9	9.1	10.826	15.23	6.152909	93.837082	0.334095
4.0	9.1	10.826	12.09	7.636763	92.363235	0.269617
4.1	9.1	10.826	9.81	9.427689	90.572311	0.218399
4.2	9.1	10.826	7.63	11.585917	88.414078	0.177716
4.3	9.1	10.826	6.06	14.160475	85.839820	0.145400
4.4	9.1	10.826	4.81	17.197037	82.892463	0.119730
4.5	9.1	10.826	3.82	20.726852	79.273149	0.099340
4.6	9.1	10.826	3.04	24.764496	75.235504	0.083143
4.7	9.1	10.826	2.41	29.297974	70.702026	0.070278
4.8	9.1	10.826	1.92	34.23214	65.716782	0.060059
4.9	9.1	10.826	1.52	39.641113	60.358887	0.051941
5.0	9.1	10.826	1.21	45.259674	54.740326	0.045493
5.1	9.1	10.826	0.96	51.001709	48.998291	0.040371

CONCENTRATIONS OF AMMONIA (NH₄⁺ NH₃) WHICH CONTAIN AN UNIONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	PH	PKA	RATIO	% UNIONIZED 4.400,11A	% UNIONIZED AMNH3	CONCENTRATION mg/L NH3
0.5	5.0	10.0643	115960.94	0.000862	99.999138	2387.55552
0.5	5.1	10.0643	92111.19	0.001085	99.998915	1836.54940
0.5	5.2	10.0643	73160.62	0.001367	99.998632	1506.52148
0.5	5.3	10.0643	58115.41	0.001721	99.998278	1195.67871
0.5	5.4	10.0643	46165.12	0.002160	99.997833	950.560303
0.5	5.5	10.0643	36670.31	0.002727	99.997269	755.062012
0.5	5.6	10.0643	29128.30	0.003433	99.996567	599.712217
0.5	5.7	10.0643	23137.47	0.004322	99.995677	476.421143
0.5	5.8	10.0643	18376.77	0.005441	99.994553	376.439597
0.5	5.9	10.0643	14598.89	0.006844	99.993159	300.609463
0.5	6.0	10.0643	11596.25	0.008623	99.991366	238.787460
0.5	6.1	10.0643	9211.25	0.010855	99.989136	189.640099
0.5	6.2	10.0643	7316.76	0.013655	99.986324	150.672623
0.5	6.3	10.0643	5811.91	0.017203	99.982788	119.647436
0.5	6.4	10.0643	4616.57	0.021650	99.978333	95.075851
0.5	6.5	10.0643	3667.08	0.027262	99.972733	75.525767
0.5	6.6	10.0643	2912.87	0.034319	99.965664	59.996597
0.5	6.7	10.0643	2313.74	0.043201	99.956787	47.661285
0.5	6.8	10.0643	1837.90	0.054380	99.945618	37.862991
0.5	6.9	10.0643	1459.90	0.068451	99.931549	30.079926
0.5	7.0	10.0643	1159.64	0.086159	99.913834	23.875984
0.5	7.1	10.0643	921.14	0.108444	99.891556	18.946786
0.5	7.2	10.0643	731.69	0.136486	99.863510	15.085995
0.5	7.3	10.0643	581.20	0.171762	99.828232	11.987483
0.5	7.4	10.0643	461.66	0.216140	99.783959	9.526246
0.5	7.5	10.0643	366.71	0.271951	99.728063	7.51214
0.5	7.6	10.0643	291.29	0.342125	99.657667	6.016271
0.5	7.7	10.0643	231.38	0.430325	99.569672	4.744726
0.5	7.8	10.0643	183.79	0.541147	99.458847	3.804683
0.5	7.9	10.0643	145.99	0.680310	99.319687	3.026563
0.5	8.0	10.0643	115.97	0.854952	99.145035	2.498322
0.5	8.1	10.0643	92.11	1.073941	98.926056	1.917236
0.5	8.2	10.0643	73.17	1.346261	98.651733	1.527152
0.5	8.3	10.0643	58.12	1.691453	98.308533	1.217296
0.5	8.4	10.0643	46.17	2.120125	97.879468	0.971169
0.5	8.5	10.0643	36.67	2.654503	97.345498	0.775463
0.5	8.6	10.0643	29.13	3.319004	96.680984	0.620367
0.5	8.7	10.0643	23.14	4.12772	95.857224	0.497010
0.5	8.8	10.0643	18.38	5.160087	94.839905	0.399024
0.5	8.9	10.0643	14.60	6.410500	93.569493	0.321191
0.5	9.0	10.0643	11.60	7.938571	92.061417	0.259367
0.5	9.1	10.0643	9.21	9.792766	90.207230	0.210257
0.5	9.2	10.0643	7.32	12.023479	87.976517	0.171248
0.5	9.3	10.0643	5.81	14.674641	85.326358	0.140262
0.5	9.4	10.0643	4.62	17.803833	82.196167	0.115649
0.5	9.5	10.0643	3.67	21.425964	78.574036	0.096098
0.5	9.6	10.0643	2.91	25.555968	74.444092	0.080568
0.5	9.7	10.0643	2.31	30.176147	69.823853	0.068233
0.5	9.8	10.0643	1.84	35.236343	64.763657	0.058434
0.5	9.9	10.0643	1.46	40.651062	59.348938	0.050651
0.5	10.0	10.0643	1.16	46.302563	53.697037	0.044468
0.5	10.1	10.0643	0.92	52.051498	47.948502	0.039557

CONCENTRATIONS OF AMMONIA (NH4-NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	pH	pKa	RATIO	A UNIONIZED AMMONIA	* IONIZED AMMONIA	CONCENTRATION (mg/L NH3)
1.0	5.0	10.041	111204.74	0.000000	97.944100	2289.72425
1.0	5.1	10.041	66333.37	0.001132	97.944854	1818.60493
1.0	5.2	10.041	70155.81	0.001427	97.945586	1444.73882
1.0	5.3	10.041	55734.75	0.001744	97.946199	1147.59888
1.0	5.4	10.041	44271.75	0.002253	97.947742	911.575484
1.0	5.5	10.041	35160.35	0.002844	97.9497147	726.095703
1.0	5.6	10.041	27933.67	0.003540	97.946414	575.174405
1.0	5.7	10.041	22144.51	0.004507	97.945403	454.842080
1.0	5.8	10.041	17624.99	0.005773	97.94324	362.519169
1.0	5.9	10.041	14000.85	0.007142	97.942844	288.281494
1.0	6.0	10.041	11120.65	0.008991	97.940997	228.944444
1.0	6.1	10.041	8833.46	0.011314	97.938674	181.901443
1.0	6.2	10.041	7016.68	0.014250	97.935749	144.404666
1.0	6.3	10.041	5573.55	0.017914	97.932056	114.774938
1.0	6.4	10.041	4427.23	0.022582	97.927417	91.177338
1.0	6.5	10.041	3516.84	0.028424	97.921573	72.422992
1.0	6.6	10.041	2793.40	0.035765	97.914203	57.536743
1.0	6.7	10.041	2216.88	0.045047	97.905441	45.707367
1.0	6.8	10.041	1762.52	0.056705	97.8943283	36.319428
1.0	6.9	10.041	1400.02	0.071370	97.881619	28.447092
1.0	7.0	10.041	1112.08	0.089441	97.867156	22.918320
1.0	7.1	10.041	883.34	0.113075	97.850917	18.208423
1.0	7.2	10.041	701.68	0.142313	97.832681	14.461122
1.0	7.3	10.041	557.36	0.179093	97.812692	11.496693
1.0	7.4	10.041	442.73	0.225363	97.791428	9.136384
1.0	7.5	10.041	351.67	0.283547	97.768446	7.261532
1.0	7.6	10.041	279.34	0.356705	97.743295	5.772283
1.0	7.7	10.041	221.69	0.448644	97.715346	4.589331
1.0	7.8	10.041	176.25	0.564163	97.684317	3.649674
1.0	7.9	10.041	140.00	0.709194	97.640802	2.903278
1.0	8.0	10.041	111.21	0.891191	97.584110	2.310394
1.0	8.1	10.041	88.34	1.119150	97.506310	1.819450
1.0	8.2	10.041	70.17	1.405112	97.408474	1.445343
1.0	8.3	10.041	55.74	1.762514	97.297473	1.168215
1.0	8.4	10.041	44.27	2.208795	97.174199	0.932182
1.0	8.5	10.041	35.17	2.764441	97.035107	0.744694
1.0	8.6	10.041	27.93	3.458045	96.883445	0.595767
1.0	8.7	10.041	22.19	4.312319	96.717483	0.477470
1.0	8.8	10.041	17.63	5.369420	96.538073	0.383503
1.0	8.9	10.041	14.00	6.664384	96.343663	0.308463
1.0	9.0	10.041	11.12	8.250071	96.136924	0.244574
1.0	9.1	10.041	8.83	10.188943	95.918994	0.202478
1.0	9.2	10.041	7.02	12.473557	95.696443	0.165064
1.0	9.3	10.041	5.57	15.211954	95.468040	0.133354
1.0	9.4	10.041	4.43	18.425973	95.235027	0.111750
1.0	9.5	10.041	3.52	22.134435	94.988505	0.093801
1.0	9.6	10.041	2.79	26.368744	94.730252	0.078108
1.0	9.7	10.041	2.22	31.085746	94.454204	0.064279
1.0	9.8	10.041	1.76	36.197430	94.162170	0.052682
1.0	9.9	10.041	1.40	41.065237	93.853473	0.044418
1.0	10.0	10.041	1.11	47.345842	93.528435	0.038489
1.0	10.1	10.041	0.88	53.095627	93.188373	0.033779

** CONCENTRATIONS OF AMMONIA (NH4+NH3) WHICH CONTAIN AN UNIONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	pH	pKa	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+ (M)
1.5	5.0	10.0240	100000.25	0.000434	99.999566	2146.15479
1.5	5.1	10.0240	84723.31	0.001149	99.998851	1746.47314
1.5	5.2	10.0240	61294.19	0.001449	99.998551	1345.65019
1.5	5.3	10.0240	53450.95	0.001871	99.998129	1108.64922
1.5	5.4	10.0240	42621.43	0.002355	99.997645	874.32621
1.5	5.5	10.0240	33729.16	0.002965	99.997035	694.513662
1.5	5.6	10.0240	26742.04	0.003732	99.996268	551.644445
1.5	5.7	10.0240	21241.72	0.004699	99.995301	434.211142
1.5	5.8	10.0240	16904.70	0.005913	99.994087	348.008135
1.5	5.9	10.0240	13427.40	0.007447	99.992553	276.500977
1.5	6.0	10.0240	10666.14	0.009375	99.990625	219.630410
1.5	6.1	10.0240	8472.45	0.011832	99.988168	174.646323
1.5	6.2	10.0240	6729.91	0.014851	99.985149	138.549474
1.5	6.3	10.0240	5345.77	0.018703	99.981297	110.049666
1.5	6.4	10.0240	4261.30	0.023444	99.976556	87.451920
1.5	6.5	10.0240	3372.44	0.029639	99.970361	69.464679
1.5	6.6	10.0240	2674.24	0.037310	99.962677	55.140184
1.5	6.7	10.0240	2128.20	0.046959	99.953041	43.460240
1.5	6.8	10.0240	1690.49	0.059119	99.940881	34.827835
1.5	6.9	10.0240	1342.81	0.074415	99.925585	27.669006
1.5	7.0	10.0240	1066.63	0.093665	99.906335	21.942513
1.5	7.1	10.0240	847.26	0.117849	99.882151	17.465591
1.5	7.2	10.0240	673.00	0.148369	99.851631	13.877671
1.5	7.3	10.0240	534.54	0.186712	99.813274	11.027676
1.5	7.4	10.0240	426.04	0.234942	99.765058	8.763844
1.5	7.5	10.0240	337.30	0.295593	99.704391	6.965607
1.5	7.6	10.0240	267.93	0.371847	99.628153	5.372227
1.5	7.7	10.0240	212.42	0.467671	99.532318	4.402613
1.5	7.8	10.0240	169.05	0.588057	99.411942	3.501359
1.5	7.9	10.0240	134.28	0.730194	99.269803	2.785467
1.5	8.0	10.0240	106.66	0.928811	99.071182	2.216413
1.5	8.1	10.0240	84.73	1.166495	98.833496	1.765116
1.5	8.2	10.0240	67.30	1.464104	98.535889	1.406317
1.5	8.3	10.0240	53.46	1.816234	98.183757	1.121314
1.5	8.4	10.0240	42.66	2.230744	97.769249	0.864928
1.5	8.5	10.0240	33.73	2.879312	97.120682	0.715101
1.5	8.6	10.0240	26.79	3.548010	96.451978	0.572260
1.5	8.7	10.0240	21.24	4.478111	95.521777	0.459798
1.5	8.8	10.0240	16.91	5.544913	94.455085	0.366672
1.5	8.9	10.0240	13.43	6.930750	93.069244	0.297082
1.5	9.0	10.0240	10.67	8.571473	91.428513	0.240215
1.5	9.1	10.0240	8.47	10.536542	89.463451	0.195045
1.5	9.2	10.0240	6.73	12.936247	87.063705	0.159165
1.5	9.3	10.0240	5.35	15.757941	84.242904	0.130664
1.5	9.4	10.0240	4.25	19.060419	80.939590	0.108025
1.5	9.5	10.0240	3.37	22.447081	77.132919	0.090042
1.5	9.6	10.0240	2.66	27.176680	72.823280	0.075758
1.5	9.7	10.0240	2.13	31.964354	68.035646	0.064411
1.5	9.8	10.0240	1.69	37.166946	62.833054	0.055399
1.5	9.9	10.0240	1.34	42.602816	57.397184	0.048240
1.5	10.0	10.0240	1.07	48.386847	51.613113	0.042553
1.5	10.1	10.0240	0.85	54.133316	45.866684	0.038034

CONCENTRATIONS OF AMMONIA (NH4+NH3) WHICH CONTAIN AN UNIONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+ (M)	CONCENTRATION NH3 (M)
2.0	5.0	10.0000	102316.75	0.000977	99.999023	2106.72144	
2.0	5.1	10.0000	41273.19	0.001230	99.998764	1673.43433	
2.0	5.2	10.0000	64557.69	0.001547	99.998454	1329.28363	
2.0	5.3	10.0000	51400.02	0.001950	99.998050	1055.87622	
2.0	5.4	10.0000	40733.23	0.002455	99.997545	838.717529	
2.0	5.5	10.0000	32355.60	0.003041	99.996959	666.222164	
2.0	5.6	10.0000	25701.01	0.003841	99.996159	529.204102	
2.0	5.7	10.0000	20415.07	0.004848	99.995152	428.366943	
2.0	5.8	10.0000	16216.24	0.006155	99.993845	333.913810	
2.0	5.9	10.0000	12661.97	0.007763	99.992237	265.281699	
2.0	6.0	10.0000	10231.82	0.009772	99.990228	210.693634	
2.0	6.1	10.0000	8127.43	0.012303	99.987697	167.364304	
2.0	6.2	10.0000	6455.45	0.015407	99.984593	132.446579	
2.0	6.3	10.0000	5140.07	0.019541	99.980459	105.807405	
2.0	6.4	10.0000	4073.38	0.024544	99.975456	83.871464	
2.0	6.5	10.0000	3235.50	0.030407	99.969593	66.622164	
2.0	6.6	10.0000	2570.14	0.038409	99.961591	52.920410	
2.0	6.7	10.0000	2041.53	0.048454	99.951545	42.836943	
2.0	6.8	10.0000	1621.65	0.061624	99.938376	33.391381	
2.0	6.9	10.0000	1266.12	0.077572	99.922428	26.528169	
2.0	7.0	10.0000	1023.14	0.097634	99.902366	21.069363	
2.0	7.1	10.0000	812.74	0.122647	99.877353	16.734304	
2.0	7.2	10.0000	645.54	0.154657	99.845343	13.213371	
2.0	7.3	10.0000	512.81	0.194623	99.805377	10.579636	
2.0	7.4	10.0000	407.34	0.244892	99.755108	8.387175	
2.0	7.5	10.0000	323.56	0.304185	99.695815	6.662216	
2.0	7.6	10.0000	257.02	0.375711	99.624289	5.292041	
2.0	7.7	10.0000	204.16	0.474333	99.525667	4.283694	
2.0	7.8	10.0000	162.17	0.612800	99.387199	3.339138	
2.0	7.9	10.0000	126.81	0.770332	99.229668	2.672873	
2.0	8.0	10.0000	102.32	0.907859	99.092141	2.106936	
2.0	8.1	10.0000	81.28	1.215414	98.784586	1.673430	
2.0	8.2	10.0000	64.54	1.525312	98.474688	1.324289	
2.0	8.3	10.0000	51.28	1.912698	97.987302	1.053322	
2.0	8.4	10.0000	40.73	2.396075	97.603925	0.838717	
2.0	8.5	10.0000	32.36	2.978775	97.021221	0.666222	
2.0	8.6	10.0000	25.70	3.745031	96.254969	0.529204	
2.0	8.7	10.0000	20.42	4.654424	95.345576	0.428369	
2.0	8.8	10.0000	16.22	5.834224	94.165777	0.333913	
2.0	8.9	10.0000	12.64	7.203781	92.796264	0.265282	
2.0	9.0	10.0000	10.23	8.902952	91.097048	0.210694	
2.0	9.1	10.0000	8.13	10.955559	89.044403	0.167343	
2.0	9.2	10.0000	6.46	13.411801	86.588196	0.132429	
2.0	9.3	10.0000	5.13	16.317764	83.682236	0.105332	
2.0	9.4	10.0000	4.07	19.710068	80.289932	0.083872	
2.0	9.5	10.0000	3.24	23.608643	76.391357	0.066624	
2.0	9.6	10.0000	2.57	28.009293	71.990707	0.052921	
2.0	9.7	10.0000	2.04	32.877224	67.122772	0.042837	
2.0	9.8	10.0000	1.62	38.142924	61.857071	0.033391	
2.0	9.9	10.0000	1.29	43.702890	56.297104	0.026528	
2.0	10.0	10.0000	1.02	49.425735	50.574265	0.021069	
2.0	10.1	10.0000	0.81	55.163660	44.836340	0.016662	

** CONCENTRATIONS OF AMMONIA (NH4+&NH3) WHICH CONTAIN AN UNIONIZED AMMONIA CONCENTRATION OF 0.02 M/L NH3-N

TEMP C	PH	PKA	RATIO	* UNIONIZED AMMONIA	* IONIZED AMMONIA	CONCENTRATION NH4-NH3
2.5	5.0	9.9920	96165.90	0.001017	99.998978	2821.23704
2.5	5.1	9.9920	77475.31	7.001262	99.998714	1805.53125
2.5	5.2	9.9920	61938.16	9.001614	99.998383	1275.32543
2.5	5.3	9.9920	49197.23	0.002033	99.997955	1013.07104
2.5	5.4	9.9920	39040.37	0.002554	99.997437	804.845383
2.5	5.5	9.9920	31042.69	0.003221	99.996765	639.149453
2.5	5.6	9.9920	24656.12	0.004055	99.995941	507.711445
2.5	5.7	9.9920	19546.67	0.005105	99.994888	403.310059
2.5	5.8	9.9920	15558.27	0.006427	99.993561	320.345234
2.5	5.9	9.9920	12358.39	0.008091	99.991898	254.674474
2.5	6.0	9.9920	9816.63	0.010146	99.989407	202.145096
2.5	6.1	9.9920	7747.64	0.012823	99.987167	160.573959
2.5	6.2	9.9920	6193.89	0.016142	99.983854	127.552795
2.5	6.3	9.9920	4919.99	0.020321	99.979675	101.323120
2.5	6.4	9.9920	3904.69	0.025561	99.974411	80.466190
2.5	6.5	9.9920	3104.31	0.032203	99.967749	63.938370
2.5	6.6	9.9920	2465.85	0.040519	99.959457	50.792358
2.5	6.7	9.9920	1954.69	0.051024	99.948959	40.350042
2.5	6.8	9.9920	1555.85	0.064232	99.935760	32.055527
2.5	6.9	9.9920	1235.86	0.080859	99.919144	25.466458
2.5	7.0	9.9920	981.64	0.101763	99.898224	20.733292
2.5	7.1	9.9920	774.77	0.128073	99.871918	16.076141
2.5	7.2	9.9920	619.40	0.161147	99.838404	12.773964
2.5	7.3	9.9920	492.01	0.202637	99.797150	10.159987
2.5	7.4	9.9920	390.81	0.255223	99.744766	8.067458
2.5	7.5	9.9920	310.44	0.318994	99.678894	6.412458
2.5	7.6	9.9920	246.59	0.403897	99.596100	5.097936
2.5	7.7	9.9920	195.87	0.507944	99.492050	4.053596
2.5	7.8	9.9920	155.59	0.638623	99.361374	3.224122
2.5	7.9	9.9920	123.59	0.802651	99.197342	2.565250
2.5	8.0	9.9920	98.17	1.009380	98.991608	2.041488
2.5	8.1	9.9920	77.98	1.266167	98.733426	1.626167
2.5	8.2	9.9920	61.94	1.581794	98.411194	1.295946
2.5	8.3	9.9920	49.20	1.991942	98.040411	1.013644
2.5	8.4	9.9920	39.08	2.496885	97.505112	0.824284
2.5	8.5	9.9920	31.04	3.120711	96.879248	0.659785
2.5	8.6	9.9920	24.66	3.897244	96.162753	0.526322
2.5	8.7	9.9920	19.59	4.857325	95.342670	0.421496
2.5	8.8	9.9920	15.56	6.039048	94.400938	0.340344
2.5	8.9	9.9920	12.36	7.485651	92.514343	0.275060
2.5	9.0	9.9920	9.82	9.244661	90.755310	0.222723
2.5	9.1	9.9920	7.88	11.345277	88.633713	0.181150
2.5	9.2	9.9920	6.19	13.900191	86.094808	0.148127
2.5	9.3	9.9920	4.92	16.891342	83.108658	0.121897
2.5	9.4	9.9920	3.91	20.373840	79.626168	0.101041
2.5	9.5	9.9920	3.10	24.383401	75.636139	0.084510
2.5	9.6	9.9920	2.47	28.852127	71.147873	0.071364
2.5	9.7	9.9920	1.96	33.767775	66.282225	0.060921
2.5	9.8	9.9920	1.56	39.124969	60.875031	0.052626
2.5	9.9	9.9920	1.24	44.724579	55.275421	0.046037
2.5	10.0	9.9920	0.94	50.461344	49.538546	0.040804
2.5	10.1	9.9920	0.78	56.185881	43.814117	0.036646

CONCENTRATIONS OF AMMONIA (NH4-NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	pH	pKa	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION ⁰⁰ NH ₄ ⁺ /M ³
3.0	5.0	9.9740	96.195.69	0.001062	99.998932	1939.50952
3.1	5.1	9.9740	74.022.44	0.001336	99.998657	1540.51450
3.2	5.2	9.9740	54.633.04	0.001643	99.998356	1273.75903
3.3	5.3	9.9740	47.209.89	0.002119	99.997879	972.372744
3.4	5.4	9.9740	37.500.20	0.002667	99.997330	772.149658
3.5	5.5	9.9740	29.747.52	0.003357	99.996643	613.365459
3.6	5.6	9.9740	23.661.10	0.004226	99.995773	487.202437
3.7	5.7	9.9740	18.744.71	0.005329	99.994675	387.093418
3.8	5.8	9.9740	14.729.17	0.006654	99.993346	307.12104
3.9	5.9	9.9740	11.058.04	0.008312	99.991682	244.140812
4.0	6.0	9.9740	8.019.70	0.010613	99.989380	193.372198
4.1	6.1	9.9740	5.842.34	0.013363	99.986633	154.042001
4.2	6.2	9.9740	4.211.77	0.016822	99.983178	122.196034
4.3	6.3	9.9740	3.050.07	0.021177	99.978821	97.227057
4.4	6.4	9.9740	2.176.79	0.026654	99.973326	77.234558
4.5	6.5	9.9740	1.580.14	0.033557	99.966431	61.353424
4.6	6.6	9.9740	1.092.64	0.042245	99.957748	46.739454
4.7	6.7	9.9740	0.749.49	0.053177	99.946823	36.719376
4.8	6.8	9.9740	0.515.17	0.066937	99.933060	30.760193
4.9	6.9	9.9740	0.345.74	0.084254	99.915741	24.637958
5.0	7.0	9.9740	0.213.64	0.106068	99.893951	19.415816
5.1	7.1	9.9740	0.133.64	0.133664	99.866531	15.426951
5.2	7.2	9.9740	0.082.11	0.167968	99.832031	12.254315
5.3	7.3	9.9740	0.047.11	0.211367	99.788620	9.741371
5.4	7.4	9.9740	0.025.01	0.265947	99.734034	7.742095
5.5	7.5	9.9740	0.013.84	0.334574	99.665421	6.154002
5.6	7.6	9.9740	0.006.67	0.420447	99.579147	4.892546
5.7	7.7	9.9740	0.003.23	0.524233	99.470764	3.890523
5.8	7.8	9.9740	0.001.30	0.665354	99.334661	3.044591
5.9	7.9	9.9740	0.000.59	0.836190	99.163403	2.442359
6.0	8.0	9.9740	0.000.20	1.050429	99.949570	1.960159
6.1	8.1	9.9740	0.000.07	1.318817	99.681143	1.561247
6.2	8.2	9.9740	0.000.00	1.654640	99.345352	1.244379
6.3	8.3	9.9740	0.000.00	2.074174	97.925812	0.992682
6.4	8.4	9.9740	0.000.00	2.597290	97.402710	0.792750
6.5	8.5	9.9740	0.000.00	3.247443	96.752045	0.633939
6.6	8.6	9.9740	0.000.00	4.054812	95.945175	0.507791
6.7	8.7	9.9740	0.000.00	5.051440	94.983346	0.407598
6.8	8.8	9.9740	0.000.00	6.277546	93.722443	0.327994
6.9	8.9	9.9740	0.000.00	7.776549	92.223450	0.264776
7.0	9.0	9.9740	0.000.00	9.596849	90.403152	0.214550
7.1	9.1	9.9740	0.000.00	11.786762	88.211227	0.174658
7.2	9.2	9.9740	0.000.00	14.401571	85.594619	0.142078
7.3	9.3	9.9740	0.000.00	17.478694	82.521381	0.117400
7.4	9.4	9.9740	0.000.00	21.051636	79.944364	0.097407
7.5	9.5	9.9740	0.000.00	25.132477	77.867523	0.081926
7.6	9.6	9.9740	0.000.00	29.760720	75.293274	0.069311
7.7	9.7	9.9740	0.000.00	34.972371	72.262629	0.059290
7.8	9.8	9.9740	0.000.00	40.727305	68.876995	0.051331
7.9	9.9	9.9740	0.000.00	47.070225	65.252975	0.045008
8.0	10.0	9.9740	0.000.00	54.092737	61.597263	0.039986
8.1	10.1	9.9740	0.000.00	61.699234	57.800764	0.035497

⁰⁰ CONCENTRATIONS OF AMMONIA (NH₄-N+3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+MH3
3.5	5.0	9.9562	40.00-69	0.001136	99.998864	1841.37855
3.5	5.1	9.9562	71.007.54	0.001393	99.998606	1478.56590
3.5	5.2	9.9562	57039.16	0.001753	99.998246	1176.45679
3.5	5.3	9.9562	45307.68	0.002267	99.997732	932.90668
3.5	5.4	9.9562	35939.35	0.002774	99.997226	741.041614
3.5	5.5	9.9562	29547.39	0.003344	99.996656	594.874766
3.5	5.6	9.9562	22707.41	0.004004	99.995996	467.574663
3.5	5.7	9.9562	18037.48	0.004754	99.995246	371.82354
3.5	5.8	9.9562	14327.70	0.005594	99.994406	295.027832
3.5	5.9	9.9562	11380.91	0.006414	99.993586	234.353438
3.5	6.0	9.9562	9040.20	0.007214	99.992786	186.158173
3.5	6.1	9.9562	7180.89	0.008004	99.991996	147.875187
3.5	6.2	9.9562	5703.99	0.008774	99.991226	117.665863
3.5	6.3	9.9562	4530.45	0.009524	99.990476	93.310745
3.5	6.4	9.9562	3593.94	0.010264	99.989736	74.12372
3.5	6.5	9.9562	2859.78	0.011004	99.988996	58.842843
3.5	6.6	9.9562	2270.81	0.011754	99.988246	46.776596
3.5	6.7	9.9562	1803.77	0.012504	99.987506	37.160263
3.5	6.8	9.9562	1432.79	0.013244	99.986756	29.521744
3.5	6.9	9.9562	1138.11	0.014004	99.985996	23.454204
3.5	7.0	9.9562	904.03	0.014754	99.985246	18.634598
3.5	7.1	9.9562	718.10	0.015504	99.984496	14.806234
3.5	7.2	9.9562	570.41	0.016264	99.983746	11.765265
3.5	7.3	9.9562	453.09	0.017004	99.982996	9.349728
3.5	7.4	9.9562	359.50	0.017754	99.982246	7.43099
3.5	7.5	9.9562	285.88	0.018504	99.981496	5.906897
3.5	7.6	9.9562	227.08	0.019264	99.980746	4.566257
3.5	7.7	9.9562	180.38	0.020004	99.980006	3.734610
3.5	7.8	9.9562	143.28	0.020754	99.979246	2.970744
3.5	7.9	9.9562	113.51	0.021504	99.978496	2.363982
3.5	8.0	9.9562	90.40	0.022244	99.977746	1.882016
3.5	8.1	9.9562	71.81	0.023004	99.976996	1.469175
3.5	8.2	9.9562	57.04	0.023754	99.976246	1.105073
3.5	8.3	9.9562	45.31	0.024504	99.975496	0.953517
3.5	8.4	9.9562	35.99	0.025264	99.974746	0.761641
3.5	8.5	9.9562	28.59	0.026004	99.973996	0.609229
3.5	8.6	9.9562	22.71	0.026754	99.973246	0.488163
3.5	8.7	9.9562	18.04	0.027504	99.972496	0.391997
3.5	8.8	9.9562	14.33	0.028264	99.971746	0.315604
3.5	8.9	9.9562	11.38	0.029004	99.970996	0.254432
3.5	9.0	9.9562	9.04	0.029754	99.970246	0.206735
3.5	9.1	9.9562	7.18	0.030504	99.969496	0.168451
3.5	9.2	9.9562	5.70	0.031264	99.968746	0.138040
3.5	9.3	9.9562	4.53	0.032004	99.967996	0.113884
3.5	9.4	9.9562	3.61	0.032754	99.967246	0.094696
3.5	9.5	9.9562	2.86	0.033504	99.966496	0.079455
3.5	9.6	9.9562	2.27	0.034264	99.965746	0.067348
3.5	9.7	9.9562	1.80	0.035004	99.964996	0.057731
3.5	9.8	9.9562	1.43	0.035754	99.964246	0.050092
3.5	9.9	9.9562	1.14	0.036504	99.963496	0.044025
3.5	10.0	9.9562	0.90	0.037264	99.962746	0.039285
3.5	10.1	9.9562	0.72	0.038004	99.961996	0.035376

.. CONCENTRATIONS OF AMMONIA (NH4+MH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.82 MG/L NH3-N

TEMP C	PH	pKa	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4-NH3
4.0	5.0	9.9344	86771.12	0.001152	99.998849	1746.63776
4.0	5.1	9.9344	84424.41	0.00151	99.998495	1419.18237
4.0	5.2	9.9344	54749.02	0.001826	99.998174	1127.30298
4.0	5.3	9.9344	43444.76	0.002244	99.997756	845.45402
4.0	5.4	9.9344	34544.40	0.002692	99.997308	711.24451
4.0	5.5	9.9344	27434.53	0.003164	99.996836	565.30244
4.0	5.6	9.9344	21744.11	0.003640	99.996360	444.40240
4.0	5.7	9.9344	17314.29	0.004176	99.995824	356.401221
4.0	5.8	9.9344	13744.44	0.004771	99.995229	283.183150
4.0	5.9	9.9344	10234.97	0.005453	99.994547	224.445068
4.0	6.0	9.9344	8677.23	0.006244	99.993756	174.644739
4.0	6.1	9.9344	6444.34	0.007166	99.992834	141.234675
4.0	6.2	9.9344	5474.54	0.008244	99.991756	112.750336
4.0	6.3	9.9344	4444.44	0.009444	99.990556	89.565216
4.0	6.4	9.9344	3454.49	0.010844	99.989156	71.148483
4.0	6.5	9.9344	2744.50	0.012444	99.987556	56.519562
4.0	6.6	9.9344	2174.56	0.014244	99.985756	44.449334
4.0	6.7	9.9344	1734.35	0.016244	99.983756	35.444699
4.0	6.8	9.9344	1374.26	0.018444	99.981556	28.337250
4.0	6.9	9.9344	1024.41	0.020844	99.979156	22.313351
4.0	7.0	9.9344	867.73	0.023444	99.976556	17.447753
4.0	7.1	9.9344	644.27	0.026244	99.973756	14.212404
4.0	7.2	9.9344	547.51	0.029244	99.970756	11.293727
4.0	7.3	9.9344	444.60	0.032444	99.967556	8.975172
4.0	7.4	9.9344	345.60	0.035844	99.964156	7.133477
4.0	7.5	9.9344	274.60	0.039444	99.960556	5.670560
4.0	7.6	9.9344	217.97	0.043244	99.956756	4.508528
4.0	7.7	9.9344	173.14	0.047244	99.952756	3.545491
4.0	7.8	9.9344	137.53	0.051444	99.948556	2.742295
4.0	7.9	9.9344	102.24	0.055844	99.944156	2.069697
4.0	8.0	9.9344	86.77	0.060444	99.939556	1.607281
4.0	8.1	9.9344	64.91	0.065244	99.934756	1.239811
4.0	8.2	9.9344	54.75	0.070244	99.929756	0.939811
4.0	8.3	9.9344	44.49	0.075444	99.924556	0.714919
4.0	8.4	9.9344	34.55	0.080844	99.919156	0.516060
4.0	8.5	9.9344	27.44	0.086444	99.913556	0.371484
4.0	8.6	9.9344	21.80	0.092244	99.907756	0.245545
4.0	8.7	9.9344	17.31	0.098244	99.901756	0.162514
4.0	8.8	9.9344	13.75	0.104444	99.895256	0.113324
4.0	8.9	9.9344	10.92	0.110844	99.888156	0.081134
4.0	9.0	9.9344	8.64	0.117444	99.880756	0.059172
4.0	9.1	9.9344	6.89	0.124244	99.873056	0.044908
4.0	9.2	9.9344	5.44	0.131244	99.865056	0.034457
4.0	9.3	9.9344	4.35	0.138444	99.856756	0.026374
4.0	9.4	9.9344	3.45	0.145844	99.848156	0.020240
4.0	9.5	9.9344	2.74	0.153444	99.839256	0.015404
4.0	9.6	9.9344	2.18	0.161244	99.830056	0.011634
4.0	9.7	9.9344	1.73	0.169244	99.820556	0.008791
4.0	9.8	9.9344	1.34	0.177444	99.810756	0.006471
4.0	9.9	9.9344	1.09	0.185844	99.800656	0.004604
4.0	10.0	9.9344	0.87	0.194444	99.790256	0.003240
4.0	10.1	9.9344	0.69	0.203244	99.779556	0.002345

** CONCENTRATIONS OF AMMONIA (NH4-NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	PRA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ -N (M)
4.3	5.0	9.9206	83244.69	0.001200	99.998795	1715.14113
4.5	5.1	9.9206	66167.37	0.001511	99.998489	1362.50674
4.5	5.2	9.9206	52550.71	0.001901	99.998099	1042.79435
4.5	5.3	9.9206	41744.63	0.002395	99.997604	859.30559
4.5	5.4	9.9206	33162.40	0.003015	99.996974	682.174229
4.5	5.5	9.9206	26341.47	0.003794	99.996204	542.39658
4.5	5.6	9.9206	20924.12	0.004714	99.995286	430.84145
4.5	5.7	9.9206	16620.65	0.005814	99.994186	362.23974
4.5	5.8	9.9206	13204.25	0.007154	99.992846	271.45498
4.5	5.9	9.9206	10486.44	0.008739	99.991261	215.44671
4.5	6.0	9.9206	8330.09	0.010603	99.989397	171.537014
4.5	6.1	9.9206	6616.43	0.012811	99.987189	136.261169
4.5	6.2	9.9206	5255.95	0.015422	99.984572	108.740402
4.5	6.3	9.9206	4174.45	0.018447	99.981553	85.982708
4.5	6.4	9.9206	3316.24	0.021901	99.978099	68.202417
4.5	6.5	9.9206	2634.12	0.025814	99.974186	54.239658
4.5	6.6	9.9206	2092.41	0.030151	99.969849	43.084145
4.5	6.7	9.9206	1662.06	0.035286	99.965314	36.23974
4.5	6.8	9.9206	1320.42	0.040603	99.960397	27.145498
4.5	6.9	9.9206	1048.64	0.046189	99.955811	21.544671
4.5	7.0	9.9206	833.01	0.051901	99.951099	17.153701
4.5	7.1	9.9206	661.64	0.057604	99.946935	13.626117
4.5	7.2	9.9206	525.60	0.063225	99.942775	10.874040
4.5	7.3	9.9206	417.50	0.068849	99.938151	8.598270
4.5	7.4	9.9206	331.63	0.074186	99.933953	6.820242
4.5	7.5	9.9206	263.43	0.079397	99.929603	5.423966
4.5	7.6	9.9206	209.25	0.084514	99.925486	4.308415
4.5	7.7	9.9206	166.21	0.089397	99.921403	3.623974
4.5	7.8	9.9206	132.03	0.094534	99.917465	2.714549
4.5	7.9	9.9206	104.87	0.099603	99.913597	2.154467
4.5	8.0	9.9206	83.30	0.104750	99.909849	1.715370
4.5	8.1	9.9206	66.17	0.109901	99.906151	1.362612
4.5	8.2	9.9206	52.56	0.115001	99.902503	1.087404
4.5	8.3	9.9206	41.75	0.120001	99.898911	0.859827
4.5	8.4	9.9206	33.16	0.124901	99.895314	0.682024
4.5	8.5	9.9206	26.34	0.129604	99.891775	0.542397
4.5	8.6	9.9206	20.92	0.134514	99.888151	0.430841
4.5	8.7	9.9206	16.62	0.139397	99.884572	0.362397
4.5	8.8	9.9206	13.20	0.144186	99.881099	0.271455
4.5	8.9	9.9206	10.49	0.148901	99.877603	0.215447
4.5	9.0	9.9206	8.33	0.153504	99.874186	0.171537
4.5	9.1	9.9206	6.62	0.157901	99.870775	0.136261
4.5	9.2	9.9206	5.26	0.162504	99.867397	0.108740
4.5	9.3	9.9206	4.18	0.167103	99.864099	0.085983
4.5	9.4	9.9206	3.32	0.171604	99.860849	0.068202
4.5	9.5	9.9206	2.63	0.176103	99.857603	0.054239
4.5	9.6	9.9206	2.09	0.180604	99.854397	0.043084
4.5	9.7	9.9206	1.66	0.185103	99.851151	0.036239
4.5	9.8	9.9206	1.32	0.189604	99.847903	0.030841
4.5	9.9	9.9206	1.05	0.194103	99.844603	0.027145
4.5	10.0	9.9206	0.83	0.198604	99.841351	0.023966
4.5	10.1	9.9206	0.66	0.203103	99.838151	0.021537

CONCENTRATIONS OF AMMONIA (NH₄-N) WHICH CONTAIN AN UNIONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	pH	PKA	RATIO	* UNIONIZED AMMONIA	* IONIZED AMMONIA	CONCENTRATION NH4+MH3 **
5.0	5.0	9.9030	79979.00	0.001250	97.998749	1646.74744
5.0	5.1	9.9030	63529.67	0.001574	97.998413	1308.07646
5.0	5.2	9.9030	50463.44	0.001942	97.998016	1039.63372
5.0	5.3	9.9030	40044.54	0.002435	97.997698	825.362061
5.0	5.4	9.9030	31640.37	0.003141	97.996857	655.613525
5.0	5.5	9.9030	25291.74	0.004177	97.995019	520.777588
5.0	5.6	9.9030	20089.97	0.005626	97.9933729	413.673046
5.0	5.7	9.9030	15958.06	0.007744	97.990667	328.546924
5.0	5.8	9.9030	12675.95	0.010943	97.987468	261.018311
5.0	5.9	9.9030	10060.44	0.015752	97.983903	207.334498
5.0	6.0	9.9030	7998.31	0.022502	97.979445	164.699446
5.0	6.1	9.9030	6353.05	0.031573	97.9746174	130.824903
5.0	6.2	9.9030	5046.41	0.044412	97.968572	103.926178
5.0	6.3	9.9030	4004.51	0.062624	97.960644	82.555493
5.0	6.4	9.9030	3164.04	0.089522	97.950241	65.540411
5.0	6.5	9.9030	2529.21	0.127765	97.937364	52.097000
5.0	6.6	9.9030	2009.03	0.184645	97.921173	41.366414
5.0	6.7	9.9030	1597.83	0.264945	97.900772	32.474677
5.0	6.8	9.9030	1267.61	0.383175	97.875122	26.107228
5.0	6.9	9.9030	1006.90	0.549612	97.842634	20.752686
5.0	7.0	9.9030	799.81	0.813360	97.802231	16.446693
5.0	7.1	9.9030	635.31	1.131369	97.751144	13.101690
5.0	7.2	9.9030	504.65	1.596315	97.689920	10.411242
5.0	7.3	9.9030	400.46	2.248332	97.617171	8.274233
5.0	7.4	9.9030	316.41	3.33914	97.534715	6.516598
5.0	7.5	9.9030	252.92	4.95242	97.442637	5.225303
5.0	7.6	9.9030	200.91	7.311833	97.342774	4.157229
5.0	7.7	9.9030	159.58	10.762700	97.237300	3.305444
5.0	7.8	9.9030	126.76	16.44904	97.12632	2.630637
5.0	7.9	9.9030	100.69	24.83360	97.016632	2.094427
5.0	8.0	9.9030	79.98	38.3360	96.903152	1.687424
5.0	8.1	9.9030	63.53	56.9612	96.785152	1.328719
5.0	8.2	9.9030	50.47	86.4304	96.65946	1.059675
5.0	8.3	9.9030	40.09	126.904	96.526096	0.845965
5.0	8.4	9.9030	31.84	184.3324	96.385074	0.676210
5.0	8.5	9.9030	25.29	267.3324	96.238591	0.541368
5.0	8.6	9.9030	20.09	384.403	96.088156	0.436259
5.0	8.7	9.9030	15.96	544.6680	95.933117	0.349180
5.0	8.8	9.9030	12.68	773.11833	95.768156	0.281598
5.0	8.9	9.9030	10.07	1093.6004	95.595948	0.227917
5.0	9.0	9.9030	8.00	1511.3169	95.418826	0.185276
5.0	9.1	9.9030	6.35	2049.315	95.238591	0.151405
5.0	9.2	9.9030	5.05	2846.147	95.056680	0.124500
5.0	9.3	9.9030	4.01	3905.332	94.875122	0.103129
5.0	9.4	9.9030	3.14	5333.353	94.688156	0.086153
5.0	9.5	9.9030	2.53	7413.6124	94.495948	0.072669
5.0	9.6	9.9030	2.01	10132.637	94.298574	0.061958
5.0	9.7	9.9030	1.60	13852.2345	94.096680	0.053449
5.0	9.8	9.9030	1.27	19092.221	93.890774	0.046691
5.0	9.9	9.9030	1.01	26482.690	93.68156	0.041323
5.0	10.0	9.9030	0.80	36403.64	93.468156	0.037059
5.0	10.1	9.9030	0.64	49360.6	93.251144	0.033672

** CONCENTRATIONS OF AMMONIA (NH4+MH3) WHICH CONTAIN AN UNIONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	pKa	RATIO	1. UNIONIZED AMMONIA	2. IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
5.5	5.0	9.8854	76801.75	0.001302	99.998694	1501.3061
5.5	5.1	9.8854	61005.07	0.001634	99.998366	1256.13135
5.5	5.2	9.8854	48458.76	0.002044	99.997955	997.796377
5.5	5.3	9.8854	38492.21	0.002594	99.997406	792.575195
5.5	5.4	9.8854	30575.50	0.003270	99.996730	629.570068
5.5	5.5	9.8854	24287.00	0.004117	99.995881	500.049444
5.5	5.6	9.8854	19291.87	0.005163	99.994837	397.240479
5.5	5.7	9.8854	15324.10	0.006525	99.993475	315.563701
5.5	5.8	9.8854	12172.39	0.008213	99.991776	250.850116
5.5	5.9	9.8854	9668.89	0.010341	99.989176	199.102875
5.5	6.0	9.8854	7680.28	0.013013	99.986555	158.157440
5.5	6.1	9.8854	6100.67	0.016344	99.983597	125.633423
5.5	6.2	9.8854	4845.94	0.020632	99.979355	99.798523
5.5	6.3	9.8854	3849.27	0.025972	99.974014	79.277084
5.5	6.4	9.8854	3057.59	0.032594	99.967300	62.976334
5.5	6.5	9.8854	2428.73	0.041157	99.959432	50.024198
5.5	6.6	9.8854	1929.21	0.051804	99.948181	39.743103
5.5	6.7	9.8854	1532.43	0.065213	99.934784	31.573349
5.5	6.8	9.8854	1217.26	0.082045	99.917908	25.043893
5.5	6.9	9.8854	966.90	0.103316	99.896643	19.929092
5.5	7.0	9.8854	768.04	0.130032	99.869965	15.834504
5.5	7.1	9.8854	610.04	0.163448	99.836349	12.582706
5.5	7.2	9.8854	484.60	0.205931	99.794057	9.998512
5.5	7.3	9.8854	384.93	0.259113	99.746475	7.946349
5.5	7.4	9.8854	305.76	0.325984	99.674011	6.31250
5.5	7.5	9.8854	242.84	0.410043	99.569951	5.021420
5.5	7.6	9.8854	192.92	0.515668	99.484329	3.992496
5.5	7.7	9.8854	153.25	0.648318	99.351669	3.175909
5.5	7.8	9.8854	121.73	0.814815	99.185181	2.524953
5.5	7.9	9.8854	96.69	1.023630	99.976364	2.011468
5.5	8.0	9.8854	76.80	1.265267	98.714722	1.602001
5.5	8.1	9.8854	61.01	1.612648	98.387314	1.276752
5.5	8.2	9.8854	48.46	2.021806	97.978190	1.018396
5.5	8.3	9.8854	38.49	2.532844	97.467941	0.813177
5.5	8.4	9.8854	30.54	3.166884	96.833099	0.650165
5.5	8.5	9.8854	24.29	3.944445	96.045547	0.520680
5.5	8.6	9.8854	19.29	4.927085	95.072113	0.417826
5.5	8.7	9.8854	15.32	6.125672	93.874313	0.336126
5.5	8.8	9.8854	12.17	7.591344	92.408646	0.271230
5.5	8.9	9.8854	9.67	9.372707	90.627289	0.219680
5.5	9.0	9.8854	7.64	11.519955	88.480042	0.178733
5.5	9.1	9.8854	6.10	14.042646	85.917313	0.146208
5.5	9.2	9.8854	4.85	17.105301	82.844694	0.120372
5.5	9.3	9.8854	3.85	20.820972	79.379028	0.099850
5.5	9.4	9.8854	3.06	26.444404	75.355591	0.083548
5.5	9.5	9.8854	2.43	34.164424	70.835571	0.070600
5.5	9.6	9.8854	1.93	46.137909	65.862091	0.060314
5.5	9.7	9.8854	1.53	61.486755	60.513245	0.052144
5.5	9.8	9.8854	1.22	85.094777	54.980223	0.045654
5.5	9.9	9.8854	0.97	120.840363	49.159437	0.040499
5.5	10.0	9.8854	0.77	165.558804	43.441132	0.036405
5.5	10.1	9.8854	0.61	225.167941	37.992859	0.033152

** CONCENTRATIONS OF AMMONIA (NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	pH	pKa	RATIO	A UNIONIZED AMMONIA	B IONIZED AMMONIA	CONCENTRATION NH ₄ ⁺ /NH ₃ **
6.0	5.0	9.8678	73761.56	0.001356	99.998642	1518.77124
6.0	5.1	9.8678	59590.94	0.001707	99.998291	1206.40746
6.0	5.2	9.8678	46540.51	0.002149	99.997849	958.289551
6.0	5.3	9.8678	36960.49	0.002703	99.997296	741.201660
6.0	5.4	9.8678	29365.16	0.003403	99.996596	604.648026
6.0	5.5	9.8678	23325.61	0.004287	99.995712	490.244922
6.0	5.6	9.8678	18528.22	0.005391	99.994599	391.516602
6.0	5.7	9.8678	14717.51	0.006794	99.993195	303.053955
6.0	5.8	9.8678	11690.55	0.008553	99.991440	240.725034
6.0	5.9	9.8678	9269.15	0.010768	99.989227	191.222382
6.0	6.0	9.8678	7376.25	0.013553	99.985445	151.897614
6.0	6.1	9.8678	5859.18	0.017066	99.982925	120.640965
6.0	6.2	9.8678	4654.11	0.021442	99.978516	95.848785
6.0	6.3	9.8678	3696.90	0.027042	99.972946	76.139771
6.0	6.4	9.8678	2936.56	0.034042	99.965958	60.484283
6.0	6.5	9.8678	2332.59	0.042874	99.957134	48.046676
6.0	6.6	9.8678	1852.85	0.053942	99.946845	38.170700
6.0	6.7	9.8678	1471.77	0.067899	99.932099	30.324371
6.0	6.8	9.8678	1169.07	0.085563	99.914536	24.091736
6.0	6.9	9.8678	926.61	0.107570	99.892426	19.141006
6.0	7.0	9.8678	737.64	0.135343	99.864609	15.204507
6.0	7.1	9.8678	585.93	0.170379	99.829620	12.044794
6.0	7.2	9.8678	465.42	0.214400	99.785599	9.603541
6.0	7.3	9.8678	369.70	0.269763	99.730225	7.632607
6.0	7.4	9.8678	293.66	0.339375	99.660614	6.067042
6.0	7.5	9.8678	233.26	0.426871	99.573120	4.823466
6.0	7.6	9.8678	185.29	0.536805	99.463191	3.835655
6.0	7.7	9.8678	147.14	0.674854	99.325134	3.051005
6.0	7.8	9.8678	116.91	0.848114	99.151886	2.427737
6.0	7.9	9.8678	92.66	1.065372	98.934616	1.932656
6.0	8.0	9.8678	73.76	1.337531	98.662460	1.539403
6.0	8.1	9.8678	58.59	1.678034	98.321960	1.227027
6.0	8.2	9.8678	46.54	2.103384	97.896606	0.974899
6.0	8.3	9.8678	36.97	2.613657	97.366333	0.741802
6.0	8.4	9.8678	29.37	3.243118	96.708479	0.625243
6.0	8.5	9.8678	23.33	4.110734	95.882952	0.500484
6.0	8.6	9.8678	18.53	5.120600	94.874395	0.402101
6.0	8.7	9.8678	14.72	6.362040	93.637909	0.323636
6.0	8.8	9.8678	11.69	7.879585	92.120407	0.261308
6.0	8.9	9.8678	9.29	9.721457	90.278534	0.211400
6.0	9.0	9.8678	7.34	11.934077	88.061920	0.172773
6.0	9.1	9.8678	5.84	14.574496	85.421494	0.141235
6.0	9.2	9.8678	4.65	17.685823	82.314377	0.116422
6.0	9.3	9.8678	3.78	21.249932	78.710064	0.096712
6.0	9.4	9.8678	2.94	25.402145	74.597655	0.081956
6.0	9.5	9.8678	2.33	30.005781	69.944217	0.068420
6.0	9.6	9.8678	1.85	35.051754	64.948242	0.058742
6.0	9.7	9.8678	1.47	40.555820	59.544174	0.050495
6.0	9.8	9.8678	1.17	46.101054	53.808346	0.044662
6.0	9.9	9.8678	0.93	51.849314	46.150681	0.039711
6.0	10.0	9.8678	0.74	57.548447	42.451553	0.035779
6.0	10.1	9.8678	0.59	63.853726	36.946274	0.032655

** CONCENTRATIONS OF AMMONIA (NH₄⁺+NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	pH	pKa	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ -NH ₃ M
6.5	5.0	9.8504	70.51.07	0.001411	99.998581	1458.86084
6.5	5.1	9.8504	56274.71	0.001777	99.998215	1158.91982
6.5	5.2	9.8504	44704.03	0.002237	99.997757	928.488770
6.5	5.3	9.8504	35510.17	0.002616	99.997377	731.17405
6.5	5.4	9.8504	28206.77	0.003543	99.996445	580.797852
6.5	5.5	9.8504	22405.47	0.004463	99.995529	461.349305
6.5	5.6	9.8504	17747.32	0.005619	99.994378	366.467529
6.5	5.7	9.8504	14146.94	0.007073	99.992920	291.100094
6.5	5.8	9.8504	11229.38	0.008904	99.991089	231.233597
6.5	5.9	9.8504	8919.83	0.011210	99.988785	183.679455
6.5	6.0	9.8504	7005.28	0.014112	99.985886	145.904540
6.5	6.1	9.8504	5626.05	0.017763	99.982224	115.902039
6.5	6.2	9.8504	4470.52	0.022364	99.977631	92.068584
6.5	6.3	9.8504	3551.07	0.028153	99.971848	73.137024
6.5	6.4	9.8504	2820.72	0.035439	99.964554	58.099121
6.5	6.5	9.8504	2240.54	0.044611	99.955383	46.154068
6.5	6.6	9.8504	1779.76	0.056156	99.943832	36.655771
6.5	6.7	9.8504	1413.71	0.070866	99.929130	29.128937
6.5	6.8	9.8504	1122.95	0.089722	99.91026	23.142197
6.5	6.9	9.8504	892.00	0.111963	99.888016	18.366765
6.5	7.0	9.8504	700.54	0.140937	99.859055	14.609378
6.5	7.1	9.8504	562.01	0.177364	99.822632	11.608087
6.5	7.2	9.8504	447.06	0.223185	99.776810	9.225517
6.5	7.3	9.8504	355.11	0.280411	99.719177	7.332334
6.5	7.4	9.8504	282.04	0.353263	99.646729	5.828524
6.5	7.5	9.8504	224.06	0.444324	99.555664	4.634093
6.5	7.6	9.8504	177.98	0.568728	99.431269	3.687159
6.5	7.7	9.8504	141.37	0.702374	99.297687	2.931465
6.5	7.8	9.8504	112.30	0.862636	99.137355	2.332784
6.5	7.9	9.8504	89.20	1.06639	99.931357	1.857232
6.5	8.0	9.8504	70.85	1.391697	99.608292	1.479484
6.5	8.1	9.8504	56.26	1.745749	99.254242	1.179436
6.5	8.2	9.8504	44.71	2.187875	97.812119	0.941096
6.5	8.3	9.8504	35.51	2.738452	97.261139	0.751775
6.5	8.4	9.8504	28.21	3.423727	96.576263	0.601391
6.5	8.5	9.8504	22.11	4.272334	95.727661	0.481937
6.5	8.6	9.8504	17.10	5.319695	94.680298	0.387052
6.5	8.7	9.8504	14.14	6.601107	93.393840	0.311681
6.5	8.8	9.8504	11.13	8.176723	91.823273	0.251412
6.5	8.9	9.8504	8.92	10.00451	89.919540	0.204257
6.5	9.0	9.8504	7.09	12.367712	87.632278	0.166482
6.5	9.1	9.8504	5.63	15.096874	84.913116	0.130476
6.5	9.2	9.8504	4.47	18.279175	81.720825	0.112642
6.5	9.3	9.8504	3.55	21.972153	78.027447	0.093789
6.5	9.4	9.8504	2.82	26.172302	73.827694	0.078671
6.5	9.5	9.8504	2.24	30.857903	69.142197	0.066725
6.5	9.6	9.8504	1.78	35.973619	64.026581	0.057237
6.5	9.7	9.8504	1.41	41.426940	58.571068	0.049780
6.5	9.8	9.8504	1.12	47.103149	52.894851	0.043713
6.5	9.9	9.8504	0.89	52.853225	47.146774	0.038957
6.5	10.0	9.8504	0.71	59.520568	41.471420	0.035179
6.5	10.1	9.8504	0.56	63.986262	36.013718	0.032179

** CONCENTRATIONS OF AMMONIA (NH₄-NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 M/L NH₃-N

TEMP C	pH	pKa	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+M3
7.0	5.0	9.8329	6800.62	0.001459	99.998541	1401.51221
7.0	5.1	9.8329	5400.73	0.001650	99.998350	1113.28655
7.0	5.2	9.8329	4294.723	0.002325	99.997675	884.103455
7.0	5.3	9.8329	3411.25	0.002931	99.997069	702.432461
7.0	5.4	9.8329	2707.95	0.003690	99.996310	557.967285
7.0	5.5	9.8329	2152.70	0.004649	99.995351	443.214111
7.0	5.6	9.8329	1707.70	0.005849	99.994151	352.662012
7.0	5.7	9.8329	1354.21	0.007361	99.992639	279.657715
7.0	5.8	9.8329	1076.55	0.009261	99.990739	222.144501
7.0	5.9	9.8329	858.14	0.011663	99.988337	176.660159
7.0	6.0	9.8329	6805.76	0.014664	99.985336	140.171707
7.0	6.1	9.8329	5400.60	0.018492	99.981508	111.166619
7.0	6.2	9.8329	4294.74	0.023274	99.976726	88.550134
7.0	6.3	9.8329	3411.27	0.029304	99.970694	70.242787
7.0	6.4	9.8329	2707.93	0.036863	99.963137	55.816040
7.0	6.5	9.8329	2152.50	0.046430	99.953570	44.340546
7.0	6.6	9.8329	1707.79	0.058452	99.941548	35.252335
7.0	6.7	9.8329	1354.14	0.073575	99.926425	27.944695
7.0	6.8	9.8329	1076.81	0.092609	99.907391	22.213276
7.0	6.9	9.8329	858.23	0.116560	99.883439	17.664764
7.0	7.0	9.8329	680.58	0.146632	99.853368	14.035886
7.0	7.1	9.8329	540.69	0.184603	99.815397	11.153352
7.0	7.2	9.8329	429.48	0.232297	99.767703	8.843664
7.0	7.3	9.8329	341.15	0.292268	99.707718	7.644905
7.0	7.4	9.8329	270.99	0.367665	99.632324	6.452647
7.0	7.5	9.8329	215.25	0.462421	99.537579	5.406214
7.0	7.6	9.8329	170.94	0.581657	99.418333	4.652647
7.0	7.7	9.8329	135.82	0.730914	99.269086	3.951101
7.0	7.8	9.8329	107.84	0.918422	99.081573	3.241703
7.0	7.9	9.8329	85.69	1.153640	99.846512	2.641884
7.0	8.0	9.8329	68.07	1.447819	99.552170	2.241884
7.0	8.1	9.8329	54.07	1.814889	99.185113	1.922139
7.0	8.2	9.8329	42.95	2.275364	97.724625	1.633441
7.0	8.3	9.8329	34.12	2.847732	97.152267	1.334411
7.0	8.4	9.8329	27.10	3.554635	96.441162	1.094910
7.0	8.5	9.8329	21.53	4.439395	95.560593	0.904910
7.0	8.6	9.8329	17.10	5.525353	94.474640	0.723032
7.0	8.7	9.8329	13.54	6.857863	93.142105	0.578560
7.0	8.8	9.8329	10.79	8.482924	91.517075	0.453602
7.0	8.9	9.8329	8.57	10.449824	89.550171	0.372646
7.0	9.0	9.8329	6.81	12.804962	87.191025	0.302238
7.0	9.1	9.8329	5.41	15.607864	84.392136	0.242723
7.0	9.2	9.8329	4.29	18.845840	81.141120	0.197037
7.0	9.3	9.8329	3.41	22.667432	77.332565	0.160747
7.0	9.4	9.8329	2.71	26.954575	73.045425	0.131421
7.0	9.5	9.8329	2.15	31.719955	68.280045	0.109023
7.0	9.6	9.8329	1.71	36.902222	63.097774	0.090435
7.0	9.7	9.8329	1.36	42.405304	57.594696	0.076384
7.0	9.8	9.8329	1.08	48.103409	51.896591	0.064912
7.0	9.9	9.8329	0.86	53.851303	46.148697	0.055796
7.0	10.0	9.8329	0.68	59.498566	40.501434	0.048555
7.0	10.1	9.8329	0.54	66.905151	35.094849	0.042404

** CONCENTRATIONS OF AMMONIA (NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	pKa	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+ NH3 **
7.5	5.0	9.8156	65400.39	0.001529	99.998459	1344.61458
7.5	5.1	9.8156	51949.41	0.001429	99.998571	1069.45469
7.5	5.2	9.8156	41264.94	0.002423	99.997577	849.645527
7.5	5.3	9.8156	32777.46	0.003051	99.996949	676.918701
7.5	5.4	9.8156	26036.49	0.003841	99.996159	536.111816
7.5	5.5	9.8156	20681.55	0.004835	99.995165	425.853760
7.5	5.6	9.8156	16427.46	0.006067	99.993933	336.272461
7.5	5.7	9.8156	13049.21	0.007663	99.992337	268.703057
7.5	5.8	9.8156	10365.37	0.009667	99.990333	213.443649
7.5	5.9	9.8156	8233.52	0.012149	99.987851	169.548794
7.5	6.0	9.8156	6540.12	0.015248	99.984752	134.641702
7.5	6.1	9.8156	5195.01	0.019246	99.980753	106.985855
7.5	6.2	9.8156	4126.55	0.024227	99.975773	84.986267
7.5	6.3	9.8156	3277.44	0.030497	99.969503	67.511322
7.5	6.4	9.8156	2603.69	0.038342	99.961658	53.630463
7.5	6.5	9.8156	2068.18	0.048324	99.951676	42.604492
7.5	6.6	9.8156	1642.62	0.060614	99.939386	33.846222
7.5	6.7	9.8156	1304.94	0.076573	99.923427	26.89297
7.5	6.8	9.8156	1036.55	0.096381	99.903619	21.363174
7.5	6.9	9.8156	823.36	0.121306	99.878693	16.973618
7.5	7.0	9.8156	654.02	0.152067	99.847321	13.486992
7.5	7.1	9.8156	519.51	0.192120	99.807877	10.717266
7.5	7.2	9.8156	412.66	0.241744	99.758255	8.517277
7.5	7.3	9.8156	327.79	0.304147	99.695853	6.769753
7.5	7.4	9.8156	260.37	0.382596	99.617401	5.381651
7.5	7.5	9.8156	206.82	0.481143	99.518857	4.279039
7.5	7.6	9.8156	164.28	0.605014	99.394974	3.403201
7.5	7.7	9.8156	130.50	0.760481	99.239517	2.707495
7.5	7.8	9.8156	103.66	0.955507	99.044479	2.154878
7.5	7.9	9.8156	82.34	1.199941	98.800049	1.715918
7.5	8.0	9.8156	65.40	1.505952	98.494034	1.367238
7.5	8.1	9.8156	51.95	1.898518	98.111481	1.090272
7.5	8.2	9.8156	41.27	2.36932	97.630664	0.870270
7.5	8.3	9.8156	32.78	2.960391	97.039597	0.695516
7.5	8.4	9.8156	26.04	3.694557	96.304337	0.556703
7.5	8.5	9.8156	20.68	4.612038	95.387955	0.446440
7.5	8.6	9.8156	16.43	5.737683	94.262314	0.358856
7.5	8.7	9.8156	13.05	7.117567	92.882431	0.284284
7.5	8.8	9.8156	10.37	8.749328	91.201660	0.234022
7.5	8.9	9.8156	8.23	10.829711	90.170288	0.190125
7.5	9.0	9.8156	6.54	13.261967	86.738083	0.155257
7.5	9.1	9.8156	5.20	16.141449	83.859551	0.127560
7.5	9.2	9.8156	4.13	19.505830	80.494370	0.105559
7.5	9.3	9.8156	3.28	23.375549	76.624451	0.088083
7.5	9.4	9.8156	2.60	27.746532	72.251465	0.074202
7.5	9.5	9.8156	2.07	32.591660	67.408340	0.063174
7.5	9.6	9.8156	1.64	37.837402	62.162598	0.054417
7.5	9.7	9.8156	1.30	43.384879	56.615921	0.047460
7.5	9.8	9.8156	1.04	49.101578	50.898422	0.041033
7.5	9.9	9.8156	0.82	54.842697	45.157303	0.037544
7.5	10.0	9.8156	0.65	60.557733	39.442267	0.034857
7.5	10.1	9.8156	0.52	65.889455	34.110555	0.031287

** CONCENTRATIONS OF AMMONIA (NH4+ NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-M

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4-NH3 **
8.0	5.0	9.7983	6267.36	0.001591	99.998398	1294.04874
8.0	5.1	9.7983	49921.54	0.002003	99.997996	1027.90479
8.0	5.2	9.7983	39654.14	0.002522	99.997467	816.499264
8.0	5.3	9.7983	31498.42	0.003175	99.996826	644.572944
8.0	5.4	9.7983	25020.12	0.003947	99.996052	515.165059
8.0	5.5	9.7983	19874.22	0.004911	99.995089	409.240713
8.0	5.6	9.7983	15785.68	0.006234	99.993765	325.044359
8.0	5.7	9.7983	12539.62	0.008077	99.991922	258.215332
8.0	5.8	9.7983	9950.75	0.010539	99.989460	205.112457
8.0	5.9	9.7983	7912.12	0.013637	99.986363	162.931061
8.0	6.0	9.7983	6284.83	0.017504	99.982495	129.425148
8.0	6.1	9.7983	4992.22	0.022027	99.977972	102.810379
8.0	6.2	9.7983	3965.47	0.027211	99.972788	81.649510
8.0	6.3	9.7983	3149.84	0.033173	99.966826	64.476740
8.0	6.4	9.7983	2502.05	0.039951	99.960037	51.537120
8.0	6.5	9.7983	1987.45	0.047908	99.952091	40.942154
8.0	6.6	9.7983	1578.69	0.057304	99.942695	32.525814
8.0	6.7	9.7983	1254.00	0.068481	99.931518	25.840439
8.0	6.8	9.7983	996.89	0.081927	99.918072	20.530045
8.0	6.9	9.7983	791.22	0.108227	99.891772	16.311859
8.0	7.0	9.7983	628.69	0.148859	99.851141	12.941214
8.0	7.1	9.7983	499.23	0.214908	99.785091	10.298706
8.0	7.2	9.7983	396.55	0.251539	99.748459	8.185595
8.0	7.3	9.7983	314.99	0.316843	99.683156	6.506293
8.0	7.4	9.7983	250.21	0.394076	99.605923	5.172376
8.0	7.5	9.7983	198.75	0.500632	99.499367	4.112604
8.0	7.6	9.7983	157.87	0.624441	99.375558	3.271156
8.0	7.7	9.7983	125.40	0.741129	99.258871	2.602610
8.0	7.8	9.7983	99.61	0.891935	99.108064	2.071585
8.0	7.9	9.7983	79.12	1.244074	98.755925	1.649738
8.0	8.0	9.7983	62.85	1.561172	98.438827	1.316671
8.0	8.1	9.7983	49.92	1.963727	98.036272	1.049515
8.0	8.2	9.7983	39.66	2.459677	97.540323	0.837102
8.0	8.3	9.7983	31.50	3.076946	96.923054	0.649169
8.0	8.4	9.7983	25.02	3.843625	96.156477	0.515776
8.0	8.5	9.7983	19.84	4.740404	95.259595	0.429417
8.0	8.6	9.7983	15.79	5.854876	94.145121	0.345651
8.0	8.7	9.7983	12.54	7.345343	92.654655	0.278795
8.0	8.8	9.7983	9.96	9.123124	90.876852	0.225490
8.0	8.9	9.7983	7.91	11.220277	88.779709	0.183507
8.0	9.0	9.7983	6.29	13.726683	86.273315	0.150000
8.0	9.1	9.7983	4.99	16.647724	83.352271	0.123384
8.0	9.2	9.7983	3.97	20.134424	79.861572	0.102242
8.0	9.3	9.7983	3.15	24.062843	75.937177	0.085449
8.0	9.4	9.7983	2.50	28.553879	71.446121	0.072109
8.0	9.5	9.7983	1.99	33.472443	66.527557	0.061513
8.0	9.6	9.7983	1.58	38.778397	61.221803	0.053097
8.0	9.7	9.7983	1.25	44.364543	55.635437	0.046411
8.0	9.8	9.7983	1.00	50.896954	49.103046	0.041100
8.0	9.9	9.7983	0.79	55.826797	44.173203	0.036982
8.0	10.0	9.7983	0.63	61.405579	38.594421	0.033531
8.0	10.1	9.7983	0.50	64.769827	35.230172	0.030870

** CONCENTRATIONS OF AMMONIA (NH4-NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	pKa	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION (M) 0.02
8.5	5.0	9.7811	60.02-70	0.001656	99.998337	1243.71214
8.5	5.1	9.7811	47974.64	0.002084	99.997910	987.421347
8.5	5.2	9.7811	38111.60	0.002624	99.997375	786.734281
8.5	5.3	9.7811	30273.17	0.003303	99.996697	623.344371
8.5	5.4	9.7811	24046.47	0.004154	99.995846	495.145752
8.5	5.5	9.7811	19101.13	0.005235	99.994765	393.312744
8.5	5.6	9.7811	15172.59	0.006590	99.993410	312.424072
8.5	5.7	9.7811	12052.04	0.008297	99.991699	248.171997
8.5	5.8	9.7811	9573.29	0.010445	99.989554	197.134491
8.5	5.9	9.7811	7604.34	0.013144	99.986856	156.593979
8.5	6.0	9.7811	6040.35	0.016553	99.983446	124.39 57
8.5	6.1	9.7811	4798.03	0.020834	99.979156	98.811981
8.5	6.2	9.7811	3811.21	0.026231	99.973755	78.493454
8.5	6.3	9.7811	3027.36	0.033071	99.966965	62.353497
8.5	6.4	9.7811	2404.72	0.041564	99.958420	49.533752
8.5	6.5	9.7811	1910.14	0.052375	99.947662	39.350357
8.5	6.6	9.7811	1517.29	0.065844	99.934128	31.261394
8.5	6.7	9.7811	1205.22	0.082904	99.917084	24.836075
8.5	6.8	9.7811	957.34	0.104347	99.895645	19.732254
8.5	6.9	9.7811	760.44	0.131323	99.868678	15.678137
8.5	7.0	9.7811	604.04	0.165277	99.834722	12.457635
8.5	7.1	9.7811	479.81	0.207983	99.792017	9.849968
8.5	7.2	9.7811	381.13	0.251693	99.738297	7.867480
8.5	7.3	9.7811	302.74	0.302274	99.697061	6.254005
8.5	7.4	9.7811	240.48	0.414121	99.585876	4.971975
8.5	7.5	9.7811	191.02	0.520784	99.479202	3.953622
8.5	7.6	9.7811	151.73	0.654750	99.345245	3.144712
8.5	7.7	9.7811	120.52	0.822885	99.177109	2.502172
8.5	7.8	9.7811	95.74	1.013747	98.986249	1.901783
8.5	7.9	9.7811	76.05	1.297935	98.702057	1.504366
8.5	8.0	9.7811	60.41	1.628528	98.371400	1.264332
8.5	8.1	9.7811	47.98	2.041583	97.958405	1.009531
8.5	8.2	9.7811	38.11	2.554683	97.443314	0.805340
8.5	8.3	9.7811	30.27	3.197501	96.802490	0.643940
8.5	8.4	9.7811	24.05	3.992355	96.007645	0.515736
8.5	8.5	9.7811	19.10	4.974047	95.025345	0.413494
8.5	8.6	9.7811	15.17	6.183067	93.816925	0.333006
8.5	8.7	9.7811	12.05	7.651354	92.338638	0.264751
8.5	8.8	9.7811	9.57	9.457451	90.542542	0.217712
8.5	8.9	9.7811	7.60	11.621622	88.378372	0.177170
8.5	9.0	9.7811	6.04	14.203341	85.796644	0.144966
8.5	9.1	9.7811	4.89	17.246554	82.753342	0.119345
8.5	9.2	9.7811	3.81	20.784088	79.215912	0.099066
8.5	9.3	9.7811	3.03	24.829391	75.170009	0.082926
8.5	9.4	9.7811	2.40	29.370132	65.630321	0.059921
8.5	9.5	9.7811	1.91	34.361674	60.275574	0.051832
8.5	9.6	9.7811	1.52	40.345917	54.650083	0.045406
8.5	9.7	9.7811	1.21	45.345917	44.651130	0.040302
8.5	9.8	9.7811	0.96	51.029684	43.197159	0.036248
8.5	9.9	9.7811	0.76	56.862441	37.058594	0.033028
8.5	10.0	9.7811	0.60	62.341492	32.424422	0.030470
8.5	10.1	9.7811	0.48	67.575376	32.424422	0.030470

CONCENTRATIONS OF AMMONIA (NH₄⁺·NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 M/L NH₃-N

TEMP C	PH	PWA	RATIO	A UN-IONIZED AMMONIA	% UN-IONIZED AMMONIA	CONCENTRATION (mg/L)
9.0	5.0	9.7639	58061.24	0.001722	94.998276	1145.50146
9.0	5.1	9.7639	46114.75	0.002164	94.997818	949.625077
9.0	5.2	9.7639	36634.27	0.002730	94.997263	754.120064
9.0	5.3	9.7639	29094.68	0.003435	94.996552	598.142461
9.0	5.4	9.7639	23116.73	0.004326	94.995667	475.952481
9.0	5.5	9.7639	18360.69	0.005460	94.994553	374.967130
9.0	5.6	9.7639	14540.44	0.006859	94.993134	300.114209
9.0	5.7	9.7639	11545.45	0.008611	94.991164	236.52567
9.0	5.8	9.7639	9202.19	0.010865	94.988120	189.493561
9.0	5.9	9.7639	7309.57	0.013674	94.984313	150.526521
9.0	6.0	9.7639	5806.20	0.017220	94.978773	119.570251
9.0	6.1	9.7639	4612.04	0.021670	94.971317	94.962494
9.0	6.2	9.7639	3663.44	0.027249	94.962702	75.451599
9.0	6.3	9.7639	2910.01	0.034352	94.952637	59.937592
9.0	6.4	9.7639	2311.50	0.043243	94.940557	47.614410
9.0	6.5	9.7639	1836.44	0.054614	94.926757	37.425775
9.0	6.6	9.7639	1454.45	0.068514	94.911473	30.053360
9.0	6.7	9.7639	1154.50	0.086114	94.894349	23.878115
9.0	6.8	9.7639	920.23	0.108614	94.873742	18.968140
9.0	6.9	9.7639	730.97	0.136714	94.849373	15.071195
9.0	7.0	9.7639	580.63	0.171931	94.820804	11.975729
9.0	7.1	9.7639	461.21	0.216352	94.783646	9.514907
9.0	7.2	9.7639	366.35	0.272218	94.727768	7.543787
9.0	7.3	9.7639	291.00	0.343240	94.657512	6.012376
9.0	7.4	9.7639	231.15	0.432749	94.569244	4.746040
9.0	7.5	9.7639	183.61	0.546171	94.459313	3.401141
9.0	7.6	9.7639	145.45	0.685744	94.319016	2.623608
9.0	7.7	9.7639	115.45	0.861171	94.142211	2.02975
9.0	7.8	9.7639	92.02	1.074986	94.925003	1.515373
9.0	7.9	9.7639	73.10	1.349569	94.650421	1.1575671
9.0	8.0	9.7639	58.06	1.630300	94.308400	0.876119
9.0	8.1	9.7639	46.12	2.022164	97.47823	0.670234
9.0	8.2	9.7639	36.64	2.557047	97.342941	0.519777
9.0	8.3	9.7639	29.10	3.322144	94.677426	0.394541
9.0	8.4	9.7639	23.12	4.366843	95.853317	0.296541
9.0	8.5	9.7639	18.34	5.744982	94.835098	0.220496
9.0	8.6	9.7639	14.59	7.416409	93.543594	0.171100
9.0	8.7	9.7639	11.59	9.45760	92.054230	0.140145
9.0	8.8	9.7639	9.20	12.033894	90.196512	0.115556
9.0	8.9	9.7639	7.31	15.691971	87.966095	0.096024
9.0	9.0	9.7639	5.81	19.018237	85.308029	0.080509
9.0	9.1	9.7639	4.61	23.442535	82.141763	0.068186
9.0	9.2	9.7639	3.66	28.574615	78.557465	0.058307
9.0	9.3	9.7639	2.91	35.576944	74.425345	0.050621
9.0	9.4	9.7639	2.31	45.258789	69.803116	0.044445
9.0	9.5	9.7639	1.84	57.674793	64.741211	0.039538
9.0	9.6	9.7639	1.46	74.627423	59.325211	0.035041
9.0	9.7	9.7639	1.16	92.076035	53.675277	0.032546
9.0	9.8	9.7639	0.92	117.770203	47.923465	0.030887
9.0	9.9	9.7639	0.73	157.770203	42.220797	
9.0	10.0	9.7639	0.58	203.265015	36.734985	
9.0	10.1	9.7639	0.46	268.435562	31.564430	

** CONCENTRATIONS OF AMMONIA (NH4-NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	pH	pKa	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+ NH3
9.5	5.0	9.7468	55618.26	0.001741	99.998259	1146.31836
9.5	5.1	9.7468	44338.09	0.002251	99.997749	912.941406
9.5	5.2	9.7468	35219.04	0.002834	99.997167	725.140664
9.5	5.3	9.7468	27975.52	0.003574	99.996426	576.036821
9.5	5.4	9.7468	22221.78	0.004503	99.995497	457.566895
9.5	5.5	9.7468	17651.41	0.005665	99.994335	363.443135
9.5	5.6	9.7468	14021.04	0.007132	99.992869	298.713623
9.5	5.7	9.7468	11137.31	0.008979	99.991021	229.337784
9.5	5.8	9.7468	8846.70	0.011302	99.988698	182.174011
9.5	5.9	9.7468	7027.19	0.014224	99.985776	144.710342
9.5	6.0	9.7468	5581.90	0.017912	99.982088	114.951889
9.5	6.1	9.7468	4433.87	0.022549	99.977441	91.313994
9.5	6.2	9.7468	3521.95	0.028345	99.971653	72.537598
9.5	6.3	9.7468	2797.59	0.035732	99.964268	57.622946
9.5	6.4	9.7468	2222.21	0.044960	99.955040	45.775864
9.5	6.5	9.7468	1765.17	0.056620	99.943379	36.365341
9.5	6.6	9.7468	1402.12	0.071270	99.928730	28.490274
9.5	6.7	9.7468	1113.75	0.089706	99.910294	22.952621
9.5	6.8	9.7468	884.64	0.112507	99.887493	18.236176
9.5	6.9	9.7468	702.73	0.142100	99.857899	14.449770
9.5	7.0	9.7468	558.20	0.178824	99.821177	11.513883
9.5	7.1	9.7468	443.39	0.225826	99.774173	9.150052
9.5	7.2	9.7468	352.20	0.283126	99.716873	7.272392
9.5	7.3	9.7468	279.76	0.356172	99.643814	5.780909
9.5	7.4	9.7468	222.22	0.447981	99.552017	4.596176
9.5	7.5	9.7468	176.52	0.563321	99.436676	3.655112
9.5	7.6	9.7468	140.21	0.708145	99.291855	2.907598
9.5	7.7	9.7468	111.38	0.854864	99.145135	2.313825
9.5	7.8	9.7468	88.47	1.017701	98.982299	1.842175
9.5	7.9	9.7468	70.27	1.203034	98.796964	1.467528
9.5	8.0	9.7468	55.82	1.459926	98.540074	1.169935
9.5	8.1	9.7468	44.34	1.795562	97.794434	0.933549
9.5	8.2	9.7468	35.22	2.260869	97.239120	0.745780
9.5	8.3	9.7468	27.98	2.851054	96.548935	0.596629
9.5	8.4	9.7468	22.22	3.601339	95.693863	0.478155
9.5	8.5	9.7468	17.65	4.561318	94.636672	0.384047
9.5	8.6	9.7468	14.02	5.857074	93.342911	0.309295
9.5	8.7	9.7468	11.14	7.538744	91.761246	0.249917
9.5	8.8	9.7468	8.85	10.155314	89.844681	0.202751
9.5	8.9	9.7468	7.03	12.457209	87.542786	0.165286
9.5	9.0	9.7468	5.58	15.142640	84.857354	0.135526
9.5	9.1	9.7468	4.43	18.402481	81.597519	0.111887
9.5	9.2	9.7468	3.52	22.113632	77.886368	0.093110
9.5	9.3	9.7468	2.80	26.331696	73.668304	0.078195
9.5	9.4	9.7468	2.22	31.033737	68.966263	0.066347
9.5	9.5	9.7468	1.77	36.163254	63.836746	0.056936
9.5	9.6	9.7468	1.40	41.828845	58.171155	0.049461
9.5	9.7	9.7468	1.11	47.308334	52.691666	0.043523
9.5	9.8	9.7468	0.88	53.050334	46.949666	0.038806
9.5	9.9	9.7468	0.70	59.728287	40.271713	0.035060
9.5	10.0	9.7468	0.56	66.175751	33.824249	0.032084
9.5	10.1	9.7468	0.44	72.808334	27.191666	0.029720

** CONCENTRATIONS OF AMMONIA (NH4+ NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	pH	pKa	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION (mg/L)
10.0	5.0	9.7297	53669.59	0.001861	99.998123	1105.07544
10.0	5.1	9.7297	42631.27	0.002348	99.997650	877.798360
10.0	5.2	9.7297	33863.27	0.002953	99.997040	697.265137
10.0	5.3	9.7297	26446.59	0.003714	99.996277	553.462540
10.0	5.4	9.7297	21346.34	0.004640	99.995316	439.453613
10.0	5.5	9.7297	16971.89	0.005692	99.994305	349.471926
10.0	5.6	9.7297	13441.24	0.007417	99.992583	277.800098
10.0	5.7	9.7297	10708.57	0.009337	99.990662	220.510193
10.0	5.8	9.7297	8506.14	0.011753	99.988235	175.161926
10.0	5.9	9.7297	6756.67	0.014798	99.985199	139.140411
10.0	6.1	9.7297	5367.02	0.018624	99.981369	110.427403
10.0	6.2	9.7297	4263.14	0.023451	99.976547	87.794530
10.0	6.3	9.7297	3386.37	0.029521	99.970474	69.746017
10.0	6.4	9.7297	2644.69	0.037142	99.962830	55.405487
10.0	6.5	9.7297	2134.66	0.046780	99.953217	44.014435
10.0	6.6	9.7297	1697.21	0.058445	99.941501	34.966202
10.0	6.7	9.7297	1344.15	0.074121	99.925873	27.777915
10.0	6.8	9.7297	1070.47	0.093245	99.906749	22.069439
10.0	6.9	9.7297	850.63	0.117423	99.882574	17.534958
10.0	7.0	9.7297	675.69	0.147761	99.852219	13.932776
10.0	7.1	9.7297	536.71	0.185744	99.814266	11.071437
10.0	7.2	9.7297	426.32	0.234014	99.765976	8.796605
10.0	7.3	9.7297	336.59	0.294424	99.705564	6.932216
10.0	7.4	9.7297	264.67	0.370340	99.629604	5.554156
10.0	7.5	9.7297	213.67	0.465813	99.534164	4.420036
10.0	7.6	9.7297	169.72	0.585742	99.414246	3.515260
10.0	7.7	9.7297	134.62	0.736244	99.263702	2.766460
10.0	7.8	9.7297	107.09	0.924160	99.074829	2.225546
10.0	7.9	9.7297	85.06	1.161924	98.838058	1.772053
10.0	8.0	9.7297	67.57	1.458393	98.541595	1.411427
10.0	8.1	9.7297	53.67	1.829101	98.170494	1.125690
10.0	8.2	9.7297	42.63	2.291843	97.708145	0.894403
10.0	8.3	9.7297	33.86	2.864236	97.131760	0.717463
10.0	8.4	9.7297	26.90	3.544270	96.451576	0.574454
10.0	8.5	9.7297	21.37	4.370631	95.629160	0.449540
10.0	8.6	9.7297	16.97	5.364026	94.635974	0.370956
10.0	8.7	9.7297	13.44	6.594202	93.404784	0.281181
10.0	8.8	9.7297	10.71	8.04426	91.954564	0.241089
10.0	8.9	9.7297	8.51	9.819133	89.480465	0.195739
10.0	9.0	9.7297	6.76	12.491679	87.108322	0.159715
10.0	9.1	9.7297	5.37	15.705347	84.294601	0.131181
10.0	9.2	9.7297	4.24	19.94264	81.000732	0.104373
10.0	9.3	9.7297	3.39	25.747165	77.202635	0.080314
10.0	9.4	9.7297	2.81	31.840127	72.899760	0.059077
10.0	9.5	9.7297	2.44	37.074326	64.119473	0.044566
10.0	9.6	9.7297	1.35	42.585770	62.925674	0.035537
10.0	9.7	9.7297	1.07	48.247794	57.142330	0.028349
10.0	9.8	9.7297	0.85	54.034760	51.712204	0.022640
10.0	9.9	9.7297	0.68	59.676407	45.965240	0.018105
10.0	10.0	9.7297	0.54	65.073146	40.323593	0.014503
10.0	10.1	9.7297	0.43	70.109451	34.926834	0.011641
					24.890549	0.009360

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UNIONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	pH	pKa	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4-NH3
10.5	5.0	9.7127	51610.45	0.001434	99.998562	1062.67449
10.5	5.1	9.7127	40945.70	0.002434	99.997562	844.122070
10.5	5.2	9.7127	32564.09	0.003071	99.996918	670.515137
10.5	5.3	9.7127	25866.62	0.003866	99.996124	532.614014
10.5	5.4	9.7127	20546.61	0.004867	99.995132	423.675439
10.5	5.5	9.7127	16320.74	0.006127	99.993866	326.065410
10.5	5.6	9.7127	12964.07	0.007713	99.992279	266.950684
10.5	5.7	9.7127	10297.75	0.009710	99.990280	212.651193
10.5	5.8	9.7127	8174.80	0.012224	99.987762	168.442719
10.5	5.9	9.7127	6497.45	0.015384	99.984604	132.933070
10.5	6.0	9.7127	5161.12	0.019372	99.980621	106.247455
10.5	6.1	9.7127	4094.62	0.024367	99.975601	84.431854
10.5	6.2	9.7127	3256.45	0.030694	99.969299	67.070944
10.5	6.3	9.7127	2586.70	0.038644	99.961349	53.280485
10.5	6.4	9.7127	2054.69	0.048653	99.951355	42.326445
10.5	6.5	9.7127	1632.10	0.061233	99.938766	32.675419
10.5	6.6	9.7127	1296.43	0.077076	99.922913	26.713074
10.5	6.7	9.7127	1029.79	0.097013	99.902985	21.223923
10.5	6.8	9.7127	817.99	0.122101	99.877899	16.863007
10.5	6.9	9.7127	649.75	0.153664	99.846324	13.394029
10.5	7.0	9.7127	516.12	0.193374	99.806610	10.667475
10.5	7.1	9.7127	409.37	0.243324	99.756668	8.461833
10.5	7.2	9.7127	325.65	0.306130	99.693848	6.725717
10.5	7.3	9.7127	258.67	0.385099	99.614899	5.346674
10.5	7.4	9.7127	205.47	0.484328	99.515671	4.251254
10.5	7.5	9.7127	163.21	0.608468	99.391822	3.341131
10.5	7.6	9.7127	129.64	0.765434	99.234554	2.669043
10.5	7.7	9.7127	102.98	0.961722	99.038269	2.140951
10.5	7.8	9.7127	81.80	1.207726	98.792267	1.764456
10.5	7.9	9.7127	64.98	1.515695	98.484294	1.354452
10.5	8.0	9.7127	51.61	1.900885	98.099104	1.043293
10.5	8.1	9.7127	41.00	2.381100	97.618894	0.844726
10.5	8.2	9.7127	32.57	2.979254	97.020737	0.691112
10.5	8.3	9.7127	25.87	3.721442	96.278046	0.553206
10.5	8.4	9.7127	20.55	4.640923	95.359670	0.443662
10.5	8.5	9.7127	16.32	5.773191	94.226807	0.356448
10.5	8.6	9.7127	12.96	7.160964	92.839035	0.287531
10.5	8.7	9.7127	10.30	8.950966	91.049022	0.232629
10.5	8.8	9.7127	8.14	10.943084	89.056903	0.189019
10.5	8.9	9.7127	6.50	13.337384	86.662598	0.154374
10.5	9.0	9.7127	5.16	16.230255	83.769745	0.126862
10.5	9.1	9.7127	4.10	19.686612	80.391384	0.105085
10.5	9.2	9.7127	3.26	23.992990	76.007804	0.087643
10.5	9.3	9.7127	2.59	27.879974	72.120026	0.073452
10.5	9.4	9.7127	2.05	32.735441	67.264359	0.062898
10.5	9.5	9.7127	1.63	37.991480	62.008514	0.054196
10.5	9.6	9.7127	1.30	43.544922	56.455678	0.047264
10.5	9.7	9.7127	1.03	49.265182	50.734818	0.041794
10.5	9.8	9.7127	0.82	55.006745	44.995255	0.037433
10.5	9.9	9.7127	0.65	60.614120	39.385880	0.033969
10.5	10.0	9.7127	0.52	65.956978	34.043030	0.031217
10.5	10.1	9.7127	0.41	70.922768	29.077240	0.029432

CONCENTRATIONS OF AMMONIA (NH4-NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	PKA	RATIO	A. UNIONIZED AMMONIA	B. IONIZED AMMONIA	CONCENTRATION NH4+MH3
11.0	5.0	9.6954	4.637.41	0.002015	94.997986	1027.05449
11.0	5.1	9.6954	3.028.45	0.002536	94.997452	811.852795
11.0	5.2	9.6954	31314.18	0.003193	94.996796	644.882324
11.0	5.3	9.6954	24871.75	0.004014	94.995912	512.253174
11.0	5.4	9.6954	19761.12	0.005060	94.994936	406.982344
11.0	5.5	9.6954	15696.84	0.006370	94.993622	323.215506
11.0	5.6	9.6954	12468.46	0.008020	94.991974	256.748094
11.0	5.7	9.6954	9904.06	0.010096	94.989844	203.945160
11.0	5.8	9.6954	7867.09	0.012710	94.987289	162.003491
11.0	5.9	9.6954	6249.05	0.016000	94.983994	126.688614
11.0	6.0	9.6954	4963.81	0.020142	94.979854	102.225344
11.0	6.1	9.6954	3942.90	0.025356	94.974846	81.204495
11.0	6.2	9.6954	3131.96	0.031914	94.968079	64.507675
11.0	6.3	9.6954	2487.81	0.040140	94.959808	51.244568
11.0	6.4	9.6954	1976.14	0.050779	94.949417	40.709305
11.0	6.5	9.6954	1569.71	0.063660	94.936325	32.340836
11.0	6.6	9.6954	1246.86	0.080137	94.919801	25.693481
11.0	6.7	9.6954	990.42	0.100465	94.899124	20.413310
11.0	6.8	9.6954	786.72	0.125944	94.873047	16.219131
11.0	6.9	9.6954	624.91	0.159769	94.840225	12.487573
11.0	7.0	9.6954	496.39	0.201050	94.798950	10.241210
11.0	7.1	9.6954	394.30	0.252972	94.748025	8.139127
11.0	7.2	9.6954	313.20	0.318268	94.681732	6.469386
11.0	7.3	9.6954	248.78	0.400345	94.594655	5.143059
11.0	7.4	9.6954	197.62	0.503443	94.486506	4.089514
11.0	7.5	9.6954	156.97	0.63021	94.356974	3.252655
11.0	7.6	9.6954	124.69	0.796621	94.204376	2.547914
11.0	7.7	9.6954	99.04	0.999567	94.00427	2.059491
11.0	7.8	9.6954	78.67	1.255130	94.748854	1.640468
11.0	7.9	9.6954	62.49	1.574944	94.425003	1.307306
11.0	8.0	9.6954	49.64	1.974744	94.025253	1.042666
11.0	8.1	9.6954	39.43	2.473402	97.526581	0.832456
11.0	8.2	9.6954	31.32	3.044016	94.905975	0.665478
11.0	8.3	9.6954	24.88	3.664173	94.135414	0.532444
11.0	8.4	9.6954	19.76	4.415510	95.143487	0.427488
11.0	8.5	9.6954	15.79	5.344933	94.011063	0.343801
11.0	8.6	9.6954	12.47	7.424474	92.575516	0.277326
11.0	8.7	9.6954	9.90	9.170552	93.829437	0.224523
11.0	8.8	9.6954	7.87	11.277250	94.722744	0.182580
11.0	8.9	9.6954	6.25	13.794400	94.205582	0.142263
11.0	9.0	9.6954	4.96	14.76227	93.232773	0.122799
11.0	9.1	9.6954	3.94	20.230377	93.768623	0.101778
11.0	9.2	9.6954	3.13	24.200630	75.799164	0.095080
11.0	9.3	9.6954	2.49	24.670441	71.329559	0.071416
11.0	9.4	9.6954	1.98	33.594640	64.400360	0.041280
11.0	9.5	9.6954	1.57	38.913380	61.046014	0.052912
11.0	9.6	9.6954	1.25	44.505474	55.44522	0.046266
11.0	9.7	9.6954	0.99	50.239624	44.7603.0	0.040984
11.0	9.8	9.6954	0.79	55.967484	44.042516	0.036784
11.0	9.9	9.6954	0.62	61.540725	34.459274	0.033458
11.0	10.0	9.6954	0.50	66.826706	33.173294	0.030611
11.0	10.1	9.6954	0.39	71.720001	24.279999	0.028709

.. CONCENTRATIONS OF AMMONIA(NH4+MH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-M

TEMP C	PH	PCA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ -NH ₃ mg
11.5	5.0	9.6789	477.66.30	9.00209	92.997894	943.116499
11.5	5.1	9.6789	379.26.29	9.002637	98.997340	746.922852
11.5	5.2	9.6789	301.25.97	9.003314	99.996674	628.316209
11.5	5.3	9.6789	239.29.46	9.004179	99.995819	492.774281
11.5	5.4	9.6789	190.04.24	9.005261	99.994736	391.600146
11.5	5.5	9.6789	150.96.00	9.006423	99.993376	310.904785
11.5	5.6	9.6789	119.73.42	9.007637	99.991653	246.955118
11.5	5.7	9.6789	95.26.73	9.008990	99.989502	196.175949
11.5	5.8	9.6789	75.07.36	9.010490	99.986746	155.832774
11.5	5.9	9.6789	60.10.98	9.012113	99.983353	123.746545
11.5	6.0	9.6789	47.74.70	9.013833	99.979050	98.231558
11.5	6.1	9.6789	37.92.69	9.015660	99.973633	78.111893
11.5	6.2	9.6789	30.12.64	9.017514	99.966812	62.056751
11.5	6.3	9.6789	23.93.02	9.019394	99.958221	49.292969
11.5	6.4	9.6789	19.00.85	9.021300	99.947414	39.159868
11.5	6.5	9.6789	15.94.90	9.023250	99.933407	31.199451
11.5	6.6	9.6789	11.94.34	9.025243	99.916687	24.715193
11.5	6.7	9.6789	9.54.69	9.027270	99.898142	19.436398
11.5	6.8	9.6789	7.56.75	9.029320	99.868027	15.401998
11.5	6.9	9.6789	6.01.11	9.031390	99.833908	12.397361
11.5	7.0	9.6789	4.77.40	9.033497	99.791000	9.851813
11.5	7.1	9.6789	3.74.27	9.035633	99.737030	7.629821
11.5	7.2	9.6789	3.01.27	9.037800	99.669159	6.223490
11.5	7.3	9.6789	2.39.31	9.040000	99.584862	4.947495
11.5	7.4	9.6789	1.90.89	9.042230	99.476609	3.934494
11.5	7.5	9.6789	1.50.94	9.044500	99.342072	3.129519
11.5	7.6	9.6789	1.17.94	9.046813	99.173126	2.490184
11.5	7.7	9.6789	9.5.27	9.049160	98.961233	1.982198
11.5	7.8	9.6789	7.5.68	9.051550	98.695801	1.578753
11.5	7.9	9.6789	6.0.11	9.053980	98.363632	1.258263
11.5	8.0	9.6789	4.7.75	9.056450	97.948619	1.003725
11.5	8.1	9.6789	3.7.93	9.058960	97.431137	0.801524
11.5	8.2	9.6789	3.0.13	9.061510	96.787369	0.646989
11.5	8.3	9.6789	2.3.93	9.064100	95.988907	0.513327
11.5	8.4	9.6789	1.9.81	9.066730	95.002243	0.411985
11.5	8.5	9.6789	1.5.10	9.069400	93.788580	0.331487
11.5	8.6	9.6789	1.1.99	9.072110	92.304492	0.267545
11.5	8.7	9.6789	9.53	9.074860	90.500717	0.216753
11.5	8.8	9.6789	7.57	9.077640	88.288701	0.176408
11.5	8.9	9.6789	6.01	9.080460	85.737137	0.144361
11.5	9.0	9.6789	4.77	9.083310	82.403655	0.118905
11.5	9.1	9.6789	3.79	9.086190	79.135529	0.098684
11.5	9.2	9.6789	3.01	9.089100	75.074498	0.084623
11.5	9.3	9.6789	2.39	9.092040	70.528641	0.074864
11.5	9.4	9.6789	1.98	9.095010	65.528298	0.069730
11.5	9.5	9.6789	1.51	9.098010	60.158798	0.061689
11.5	9.6	9.6789	1.20	9.101040	54.533234	0.052866
11.5	9.7	9.6789	0.95	9.104100	48.769205	0.043287
11.5	9.8	9.6789	0.76	9.107190	43.077574	0.036172
11.5	9.9	9.6789	0.60	9.110310	37.544128	0.032967
11.5	10.0	9.6789	0.48	9.113460	32.317406	0.030422
11.5	10.1	9.6789	0.38	9.116630	27.444871	0.028460

CONCENTRATIONS OF AMMONIA (NH₄-NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	PH	PHA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ -NH ₃ mg/L
12.0	5.0	9.6621	45933.37	0.00217	99.997818	945.748576
12.0	5.1	9.6621	36446.23	0.002741	99.997253	751.271973
12.0	5.2	9.6621	28982.09	0.003450	99.996550	596.761475
12.0	5.3	9.6621	23021.32	0.004344	99.995656	474.023441
12.0	5.4	9.6621	18246.50	0.005444	99.994556	376.519551
12.0	5.5	9.6621	14525.50	0.006844	99.993156	299.100506
12.0	5.6	9.6621	11518.03	0.008666	99.991333	237.544444
12.0	5.7	9.6621	9165.09	0.010910	99.989090	188.727651
12.0	5.8	9.6621	7289.03	0.013734	99.986266	149.916351
12.0	5.9	9.6621	5782.74	0.017290	99.982710	115.087219
12.0	6.0	9.6621	4593.40	0.021765	99.978235	94.598740
12.0	6.1	9.6621	3644.67	0.027400	99.972595	75.146774
12.0	6.2	9.6621	2898.25	0.034442	99.965558	59.695465
12.0	6.3	9.6621	2302.16	0.043414	99.956586	47.422089
12.0	6.4	9.6621	1824.67	0.054455	99.945545	37.672489
12.0	6.5	9.6621	1452.57	0.068496	99.931504	29.929016
12.0	6.6	9.6621	1151.52	0.086544	99.913456	23.777725
12.0	6.7	9.6621	916.51	0.109590	99.890410	18.491571
12.0	6.8	9.6621	728.01	0.137172	99.862828	15.010374
12.0	6.9	9.6621	578.24	0.172627	99.827373	11.927414
12.0	7.0	9.6621	459.35	0.217224	99.782776	9.478533
12.0	7.1	9.6621	364.47	0.273320	99.726680	7.533305
12.0	7.2	9.6621	289.83	0.343445	99.656155	5.981611
12.0	7.3	9.6621	230.22	0.432490	99.567505	4.749806
12.0	7.4	9.6621	182.87	0.543863	99.456131	3.785882
12.0	7.5	9.6621	145.26	0.683714	99.316286	3.011473
12.0	7.6	9.6621	115.18	0.859224	99.140776	2.366337
12.0	7.7	9.6621	91.65	1.074301	98.925695	1.907716
12.0	7.8	9.6621	72.80	1.354971	98.645020	1.519589
12.0	7.9	9.6621	57.83	1.698442	98.300156	1.211288
12.0	8.0	9.6621	45.94	2.130595	97.869400	0.966397
12.0	8.1	9.6621	36.45	2.667542	97.332458	0.771672
12.0	8.2	9.6621	28.98	3.335194	96.664795	0.617355
12.0	8.3	9.6621	23.02	4.162807	95.837194	0.494618
12.0	8.4	9.6621	18.29	5.184772	94.815216	0.397124
12.0	8.5	9.6621	14.53	6.440766	93.559219	0.315682
12.0	8.6	9.6621	11.54	7.975424	92.024567	0.258164
12.0	8.7	9.6621	9.17	9.837313	90.162674	0.209305
12.0	8.8	9.6621	7.28	12.076824	87.923112	0.170492
12.0	8.9	9.6621	5.78	14.742795	85.257202	0.139661
12.0	9.0	9.6621	4.59	17.877604	82.122391	0.115172
12.0	9.1	9.6621	3.65	21.510818	78.489182	0.095719
12.0	9.2	9.6621	2.90	25.651764	74.348236	0.080267
12.0	9.3	9.6621	2.30	30.242303	69.717697	0.067993
12.0	9.4	9.6621	1.81	35.351284	64.648712	0.058244
12.0	9.5	9.6621	1.45	40.772552	59.227448	0.050500
12.0	9.6	9.6621	1.15	46.428116	53.571894	0.043448
12.0	9.7	9.6621	0.92	52.177094	47.822406	0.039462
12.0	9.8	9.6621	0.73	57.868942	42.131059	0.035580
12.0	9.9	9.6621	0.58	63.359085	36.640915	0.032497
12.0	10.0	9.6621	0.46	68.522944	31.477051	0.030048
12.0	10.1	9.6621	0.36	73.266113	26.733887	0.028103

** CONCENTRATIONS OF AMMONIA (NH₄-NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+MH3 mg/L
12.5	5.0	9.6454	44195.39	0.00226J	99.997726	910.003662
12.5	5.1	9.6454	35105.70	0.00284H	99.997147	722.466680
12.5	5.2	9.6454	27885.49	0.003586	99.996414	574.192461
12.5	5.3	9.6454	22150.27	0.004514	99.995483	456.094727
12.5	5.4	9.6454	17544.61	0.005643	99.994357	362.293457
12.5	5.5	9.6454	13975.90	0.007155	99.992844	287.744224
12.5	5.6	9.6454	11101.47	0.009087	99.990912	226.599423
12.5	5.7	9.6454	8818.22	0.011339	99.988661	181.547784
12.5	5.8	9.6454	7004.57	0.014274	99.985718	144.244766
12.5	5.9	9.6454	5563.44	0.017979	99.982025	114.542042
12.5	6.0	9.6454	4419.60	0.022621	99.977371	91.020187
12.5	6.1	9.6454	3510.62	0.028477	99.971512	72.304214
12.5	6.2	9.6454	2788.59	0.035864	99.964142	57.437607
12.5	6.3	9.6454	2215.05	0.045125	99.954865	45.624555
12.5	6.4	9.6454	1754.46	0.056403	99.943192	36.248337
12.5	6.5	9.6454	1397.61	0.071500	99.928497	28.797363
12.5	6.6	9.6454	1110.16	0.089966	99.910004	22.476815
12.5	6.7	9.6454	881.43	0.113271	99.886719	18.177551
12.5	6.8	9.6454	700.47	0.142553	99.857437	14.443207
12.5	6.9	9.6454	556.46	0.179404	99.820587	11.476498
12.5	7.0	9.6454	441.97	0.225751	99.774246	9.120667
12.5	7.1	9.6454	351.07	0.284037	99.715948	7.264951
12.5	7.2	9.6454	278.86	0.357319	99.642679	5.762365
12.5	7.3	9.6454	221.51	0.444221	99.550568	4.581450
12.5	7.4	9.6454	175.95	0.546124	99.453860	3.643415
12.5	7.5	9.6454	139.76	0.671045	99.328951	2.894307
12.5	7.6	9.6454	111.02	0.827116	99.17285	2.308445
12.5	7.7	9.6454	88.18	1.021264	98.978723	1.836313
12.5	7.8	9.6454	70.05	1.267505	98.732484	1.442872
12.5	7.9	9.6454	55.64	1.565804	98.437582	1.162336
12.5	8.0	9.6454	44.20	2.021527	97.977460	0.930610
12.5	8.1	9.6454	35.11	2.769537	97.230453	0.743445
12.5	8.2	9.6454	27.89	3.461811	96.538177	0.594775
12.5	8.3	9.6454	22.15	4.319439	95.680557	0.476482
12.5	8.4	9.6454	17.60	5.377696	94.622299	0.382874
12.5	8.5	9.6454	13.98	6.677139	93.322861	0.308346
12.5	8.6	9.6454	11.10	8.263145	91.736847	0.249179
12.5	8.7	9.6454	8.82	10.184763	89.815231	0.202165
12.5	8.8	9.6454	7.00	12.492405	87.507584	0.164420
12.5	8.9	9.6454	5.56	15.234232	84.765762	0.135156
12.5	9.0	9.6454	4.42	18.450920	81.549072	0.111593
12.5	9.1	9.6454	3.51	22.109205	77.830795	0.092877
12.5	9.2	9.6454	2.79	26.394272	73.605728	0.078009
12.5	9.3	9.6454	2.22	31.102768	68.897232	0.066200
12.5	9.4	9.6454	1.76	36.237701	63.762299	0.056819
12.5	9.5	9.6454	1.40	41.707199	58.292801	0.049368
12.5	9.6	9.6454	1.11	47.308672	52.691128	0.043449
12.5	9.7	9.6454	0.88	53.130411	46.861389	0.038748
12.5	9.8	9.6454	0.70	59.886381	41.1193619	0.035013
12.5	9.9	9.6454	0.56	68.259832	35.750168	0.032047
12.5	10.0	9.6454	0.44	79.346877	30.651123	0.029490
12.5	10.1	9.6454	0.35	94.014001	25.985199	0.027819

88. CONCENTRATIONS OF AMMONIA (NH4+MH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	pH	pKa	RATIO	A UNIONIZED AMMONIA	A IONIZED AMMONIA	CONCENTRATION NH4+NH3
13.0	5.0	9.6287	42528.49	0.002351	99.997649	875.590430
13.0	5.1	9.6287	33741.92	0.002940	99.997060	695.560044
13.0	5.2	9.6287	26833.97	0.003720	99.996280	552.531482
13.0	5.3	9.6287	21315.01	0.004691	99.995309	438.566729
13.0	5.4	9.6287	16931.14	0.005900	99.994099	348.632412
13.0	5.5	9.6287	13448.90	0.007435	99.992565	276.913150
13.0	5.6	9.6287	10682.86	0.009360	99.990640	219.940713
13.0	5.7	9.6287	8455.71	0.011743	99.988257	174.741364
13.0	5.8	9.6287	6740.45	0.014634	99.985366	138.408427
13.0	5.9	9.6287	5354.13	0.018174	99.981826	110.242192
13.0	6.0	9.6287	4252.95	0.022504	99.977496	87.548730
13.0	6.1	9.6287	3374.24	0.027952	99.972048	69.575506
13.0	6.2	9.6287	2683.43	0.034752	99.965248	55.272491
13.0	6.3	9.6287	2131.53	0.043130	99.956870	43.908194
13.0	6.4	9.6287	1693.14	0.053421	99.946579	34.862274
13.0	6.5	9.6287	1344.86	0.066057	99.933943	27.691350
13.0	6.6	9.6287	1068.29	0.081299	99.918701	21.994071
13.0	6.7	9.6287	845.57	0.099360	99.900640	17.474136
13.0	6.8	9.6287	674.05	0.120743	99.879257	13.840842
13.0	6.9	9.6287	535.41	0.146340	99.853660	11.024219
13.0	7.0	9.6287	425.29	0.177496	99.822048	8.754873
13.0	7.1	9.6287	337.42	0.213150	99.785350	6.957506
13.0	7.2	9.6287	268.34	0.253421	99.746579	5.527249
13.0	7.3	9.6287	213.15	0.299360	99.704099	4.385667
13.0	7.4	9.6287	169.31	0.352048	99.657943	3.486324
13.0	7.5	9.6287	134.49	0.413150	99.608194	2.769131
13.0	7.6	9.6287	106.83	0.481826	99.554099	2.199407
13.0	7.7	9.6287	84.56	0.558257	99.495366	1.747413
13.0	7.8	9.6287	67.41	0.646057	99.433943	1.384084
13.0	7.9	9.6287	53.54	0.742048	99.368701	1.102422
13.0	8.0	9.6287	42.53	0.847496	99.300640	0.875487
13.0	8.1	9.6287	33.74	0.962943	99.229257	0.695755
13.0	8.2	9.6287	26.84	1.081299	99.154701	0.552724
13.0	8.3	9.6287	21.32	1.207496	99.077943	0.438567
13.0	8.4	9.6287	16.93	1.342048	99.000640	0.348622
13.0	8.5	9.6287	13.45	1.481826	98.922048	0.276913
13.0	8.6	9.6287	10.68	1.629257	98.840842	0.219940
13.0	8.7	9.6287	8.49	1.781299	98.757943	0.174741
13.0	8.8	9.6287	6.74	1.937496	98.672048	0.138408
13.0	8.9	9.6287	5.35	2.100640	98.585366	0.110242
13.0	9.0	9.6287	4.25	2.272048	98.500640	0.087548
13.0	9.1	9.6287	3.38	2.452943	98.418701	0.069575
13.0	9.2	9.6287	2.68	2.642943	98.339257	0.055272
13.0	9.3	9.6287	2.13	2.842943	98.262048	0.043856
13.0	9.4	9.6287	1.69	3.052943	98.187943	0.034862
13.0	9.5	9.6287	1.34	3.272943	98.116040	0.027691
13.0	9.6	9.6287	1.07	3.502943	98.047943	0.021994
13.0	9.7	9.6287	0.85	3.742943	97.983943	0.017474
13.0	9.8	9.6287	0.67	4.002943	97.924099	0.013840
13.0	9.9	9.6287	0.54	4.272943	97.868701	0.011024
13.0	10.0	9.6287	0.43	4.552943	97.816040	0.008754
13.0	10.1	9.6287	0.34	4.842943	97.767943	0.006957

CONCENTRATIONS OF AMMONIA (NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+ MG/L
13.5	5.0	9.6121	40930.70	0.002443	99.997553	842.18547
13.5	5.1	9.6121	32512.43	0.003076	99.996924	669.51614
13.5	5.2	9.6121	25825.57	0.003872	99.996128	531.74983
13.5	5.3	9.6121	20514.02	0.004874	99.995127	422.404297
13.5	5.4	9.6121	16294.94	0.006137	99.993863	335.532227
13.5	5.5	9.6121	12943.50	0.007725	99.992275	266.527344
13.5	5.6	9.6121	10281.41	0.009725	99.990275	211.716737
13.5	5.7	9.6121	8166.82	0.012243	99.987757	168.175567
13.5	5.8	9.6121	6487.15	0.015413	99.984587	133.540073
13.5	5.9	9.6121	5152.93	0.019403	99.980597	106.119431
13.5	6.0	9.6121	4093.12	0.024425	99.975575	84.297974
13.5	6.1	9.6121	3251.29	0.030744	99.969236	66.966584
13.5	6.2	9.6121	2582.59	0.038706	99.961294	53.196167
13.5	6.3	9.6121	2051.43	0.048723	99.951277	42.254521
13.5	6.4	9.6121	1629.51	0.061330	99.938670	33.572220
13.5	6.5	9.6121	1294.37	0.077198	99.922802	26.671631
13.5	6.6	9.6121	1028.16	0.097167	99.902832	21.192292
13.5	6.7	9.6121	816.49	0.122255	99.877745	16.436304
13.5	6.8	9.6121	648.72	0.154512	99.845488	13.377403
13.5	6.9	9.6121	515.30	0.194686	99.805314	10.639613
13.5	7.0	9.6121	409.32	0.243713	99.756287	8.468445
13.5	7.1	9.6121	325.13	0.306623	99.693377	6.715083
13.5	7.2	9.6121	258.26	0.385709	99.614291	5.334223
13.5	7.3	9.6121	205.15	0.485094	99.514895	4.244562
13.5	7.4	9.6121	162.95	0.609930	99.390070	3.375799
13.5	7.5	9.6121	129.44	0.766644	99.233356	2.665731
13.5	7.6	9.6121	102.82	0.963235	99.036765	2.137588
13.5	7.7	9.6121	81.67	1.209622	98.790375	1.702184
13.5	7.8	9.6121	64.87	1.518067	98.481918	1.356329
13.5	7.9	9.6121	51.53	1.903644	98.096344	1.061697
13.5	8.0	9.6121	40.93	2.384742	97.615204	0.863387
13.5	8.1	9.6121	32.51	2.943849	97.056151	0.690048
13.5	8.2	9.6121	25.83	3.727636	96.272354	0.552361
13.5	8.3	9.6121	20.51	4.647949	95.352051	0.442991
13.5	8.4	9.6121	16.30	5.741829	94.258170	0.356116
13.5	8.5	9.6121	12.94	7.171528	92.828461	0.287108
13.5	8.6	9.6121	10.24	8.863815	91.136185	0.232293
13.5	8.7	9.6121	8.17	10.902510	89.091474	0.188752
13.5	8.8	9.6121	6.49	13.355752	86.64241	0.154166
13.5	8.9	9.6121	5.15	16.251862	83.748138	0.126693
13.5	9.0	9.6121	4.09	19.633667	80.366333	0.104871
13.5	9.1	9.6121	3.25	23.521530	76.478470	0.087537
13.5	9.2	9.6121	2.58	27.911911	72.088099	0.073768
13.5	9.3	9.6121	2.05	32.770599	67.229401	0.062431
13.5	9.4	9.6121	1.63	38.028915	61.971085	0.054143
13.5	9.5	9.6121	1.29	43.583969	56.416031	0.047242
13.5	9.6	9.6121	1.03	49.304855	50.695145	0.041761
13.5	9.7	9.6121	0.82	55.044052	44.955948	0.037406
13.5	9.8	9.6121	0.65	60.651993	39.348007	0.033948
13.5	9.9	9.6121	0.52	65.992615	34.007385	0.031200
13.5	10.0	9.6121	0.41	70.955498	29.044510	0.029016
13.5	10.1	9.6121	0.33	75.463333	24.536667	0.027285

** CONCENTRATIONS OF AMMONIA (NH4+ NH3) WHICH CONTAIN AN UNIONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	PKA	RATIO	μ UNIONIZED AMMONIA	μ IONIZED AMMONIA	CONCENTRATION NH ₄ ⁺ NH ₃
14.0	5.0	9.5955	32397.74	0.002538	99.997462	811.214471
14.0	5.1	9.5955	31246.79	0.003164	99.996836	644.340127
14.0	5.2	9.5955	24850.37	9.004023	99.995972	511.454248
14.0	5.3	9.5955	19745.71	0.005064	99.994936	406.544461
14.0	5.4	9.5955	15046.60	0.006375	99.993622	322.444553
14.0	5.5	9.5955	12454.74	0.008026	99.991974	256.545094
14.0	5.6	9.5955	9956.74	0.010104	99.989883	203.744362
14.0	5.7	9.5955	7800.94	0.012714	99.987274	161.477625
14.0	5.8	9.5955	6244.19	0.016012	99.983978	128.548379
14.0	5.9	9.5955	4954.94	0.020157	99.979843	102.145767
14.0	6.0	9.5955	3739.83	0.025375	99.974625	81.141447
14.0	6.1	9.5955	2745.87	0.031444	99.968555	64.457357
14.0	6.2	9.5955	1974.86	0.040211	99.960788	51.204420
14.0	6.3	9.5955	1474.86	0.050618	99.951381	40.677567
14.0	6.4	9.5955	1068.44	0.063715	99.936279	32.315628
14.0	6.5	9.5955	785.59	0.080144	99.919856	25.673492
14.0	6.6	9.5955	585.65	0.100444	99.899556	20.197446
14.0	6.7	9.5955	430.11	0.127046	99.872940	16.204512
14.0	6.8	9.5955	312.46	0.159691	99.840103	12.477553
14.0	6.9	9.5955	224.99	0.201207	99.794782	10.233241
14.0	7.0	9.5955	163.46	0.253172	99.740426	8.132403
14.0	7.1	9.5955	119.44	0.318510	99.681473	6.444355
14.0	7.2	9.5955	84.59	0.400857	99.599143	5.134065
14.0	7.3	9.5955	60.85	0.503173	99.496826	4.044345
14.0	7.4	9.5955	44.85	0.633511	99.366446	3.250134
14.0	7.5	9.5955	32.59	0.796236	99.201751	2.545615
14.0	7.6	9.5955	22.97	1.000334	99.099666	2.054305
14.0	7.7	9.5955	16.61	1.255090	98.943496	1.639206
14.0	7.8	9.5955	12.44	1.576203	98.743496	1.304303
14.0	7.9	9.5955	9.40	1.976254	98.423743	1.041469
14.0	8.0	9.5955	6.86	2.475287	97.924704	0.811422
14.0	8.1	9.5955	5.00	3.046354	97.304641	0.644475
14.0	8.2	9.5955	3.64	3.687067	96.513291	0.532444
14.0	8.3	9.5955	2.64	4.420082	95.579916	0.427171
14.0	8.4	9.5955	1.95	5.343320	94.500668	0.343549
14.0	8.5	9.5955	1.46	6.477052	93.2570160	0.277126
14.0	8.6	9.5955	1.09	7.829831	91.822437	0.224364
14.0	8.7	9.5955	0.80	9.177052	89.146304	0.182454
14.0	8.8	9.5955	0.58	11.265054	85.146304	0.149163
14.0	8.9	9.5955	0.42	13.493683	80.146304	0.122719
14.0	9.0	9.5955	0.31	16.774107	74.146304	0.101714
14.0	9.1	9.5955	0.22	20.242950	67.146304	0.085029
14.0	9.2	9.5955	0.16	24.215134	59.146304	0.071776
14.0	9.3	9.5955	0.11	28.646306	50.146304	0.061249
14.0	9.4	9.5955	0.08	33.617050	41.146304	0.052446
14.0	9.5	9.5955	0.06	39.325206	32.146304	0.044968
14.0	9.6	9.5955	0.04	45.827114	24.264191	0.038447
14.0	9.7	9.5955	0.03	53.259125	17.633234	0.032403
14.0	9.8	9.5955	0.02	61.986694		0.028703
14.0	9.9	9.5955	0.02	71.559184		0.027034
14.0	10.0	9.5955	0.01	82.443964		
14.0	10.1	9.5955	0.01	94.735804		
14.0	10.2	9.5955	0.01	108.163234		

.. CONCENTRATIONS OF AMMONIA (NH₄⁺ NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	pH	pKa	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+M3
14.5	5.0	9.5790	37927.37	0.002537	99.997308	740.945068
14.5	5.1	9.5790	30126.83	0.003314	99.996684	670.331787
14.5	5.2	9.5790	23930.61	0.004174	99.995824	642.751553
14.5	5.3	9.5790	19008.78	0.005263	99.994736	591.611177
14.5	5.4	9.5790	15099.23	0.006522	99.993478	510.913814
14.5	5.5	9.5790	11993.77	0.0080337	99.9919653	446.972168
14.5	5.6	9.5790	9527.00	0.010495	99.989504	396.161444
14.5	5.7	9.5790	7567.54	0.013213	99.986786	355.836960
14.5	5.8	9.5790	6011.15	0.016633	99.983366	323.760070
14.5	5.9	9.5790	4776.43	0.020914	99.979085	298.134341
14.5	6.0	9.5790	3742.79	0.026354	99.973633	278.114444
14.5	6.1	9.5790	3012.72	0.033182	99.966812	262.052521
14.5	6.2	9.5790	2393.09	0.041764	99.958221	249.794373
14.5	6.3	9.5790	1900.90	0.052579	99.947418	239.160202
14.5	6.4	9.5790	1509.94	0.066144	99.933857	231.110352
14.5	6.5	9.5790	1199.39	0.083309	99.916687	224.716095
14.5	6.6	9.5790	952.71	0.104453	99.895542	219.676948
14.5	6.7	9.5790	756.77	0.131904	99.868027	215.602446
14.5	6.8	9.5790	601.12	0.164074	99.835926	212.357718
14.5	6.9	9.5790	477.49	0.204691	99.795308	209.852093
14.5	7.0	9.5790	374.24	0.252951	99.737030	207.830841
14.5	7.1	9.5790	301.24	0.30823	99.69174	206.223870
14.5	7.2	9.5790	239.31	0.36125	99.638642	205.06036
14.5	7.3	9.5790	190.09	0.423305	99.576685	204.344866
14.5	7.4	9.5790	151.00	0.497910	99.502087	204.06968
14.5	7.5	9.5790	119.94	0.582650	99.417341	204.18174
14.5	7.6	9.5790	95.27	0.678716	99.321273	204.2254
14.5	7.7	9.5790	75.64	0.784154	99.215841	204.2795
14.5	7.8	9.5790	60.11	0.893310	99.106674	204.3319
14.5	7.9	9.5790	47.75	1.001294	98.998700	204.3754
14.5	8.0	9.5790	37.93	1.108763	98.891233	204.41546
14.5	8.1	9.5790	30.13	1.215236	98.784760	204.4526
14.5	8.2	9.5790	23.93	1.31974	98.679014	204.51342
14.5	8.3	9.5790	19.01	1.421236	98.582390	204.51997
14.5	8.4	9.5790	15.10	1.518236	98.48757	204.53146
14.5	8.5	9.5790	11.99	1.6095704	98.394291	204.54752
14.5	8.6	9.5790	9.53	1.694033	98.300961	204.56759
14.5	8.7	9.5790	7.57	1.771494	98.208506	204.5913
14.5	8.8	9.5790	6.01	1.842504	98.117488	204.61365
14.5	8.9	9.5790	4.78	1.90913	98.028067	204.63904
14.5	9.0	9.5790	3.79	1.963998	97.940082	204.66587
14.5	9.1	9.5790	3.01	2.00988	97.853832	204.69424
14.5	9.2	9.5790	2.39	2.0470764	97.769236	204.72466
14.5	9.3	9.5790	1.90	2.071064	97.686931	204.75731
14.5	9.4	9.5790	1.51	2.08513	97.606485	204.79281
14.5	9.5	9.5790	1.20	2.090444	97.528351	204.83027
14.5	9.6	9.5790	0.95	2.08764	97.452337	204.86972
14.5	9.7	9.5790	0.76	2.07107	97.378293	204.91172
14.5	9.8	9.5790	0.60	2.045200	97.306400	204.95660
14.5	9.9	9.5790	0.48	2.011503	97.236997	204.99420
14.5	10.0	9.5790	0.38	2.000580	97.169420	205.02800
14.5	10.1	9.5790	0.30	2.004493	97.103107	205.06794

** CONCENTRATIONS OF AMMONIA (NH4+M3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 M/L NH3-N

TEMP C	pH	pKa	RATIO	UNIONIZED AMMONIA	IONIZED AMMONIA	CONCENTRATION NH4-N M	CONCENTRATION NH3-N
15.0	5.0	9.5625	36516.54	0.002734	92.497253	751.446722	
15.0	5.1	9.5625	29006.20	0.003447	92.496552	597.258057	
15.0	5.2	9.5625	23040.47	0.004340	92.495651	474.424072	
15.0	5.3	9.5625	18301.73	0.005444	92.494522	374.453271	
15.0	5.4	9.5625	14537.60	0.006874	92.493114	299.445409	
15.0	5.5	9.5625	11547.64	0.008654	92.491333	237.446575	
15.0	5.6	9.5625	9176.63	0.010901	92.489040	188.445010	
15.0	5.7	9.5625	7246.09	0.013723	92.486267	150.441199	
15.0	5.8	9.5625	5787.56	0.017275	92.482712	119.446401	
15.0	5.9	9.5625	4597.22	0.021744	92.478241	94.677414	
15.0	6.0	9.5625	3651.71	0.027377	92.472610	75.204259	
15.0	6.1	9.5625	2900.64	0.034443	92.465530	59.745163	
15.0	6.2	9.5625	2304.04	0.043342	92.456604	47.441578	
15.0	6.3	9.5625	1830.20	0.054404	92.445343	37.404361	
15.0	6.4	9.5625	1453.74	0.068734	92.431259	29.453914	
15.0	6.5	9.5625	1154.74	0.086522	92.413667	23.797514	
15.0	6.6	9.5625	917.24	0.108400	92.391094	18.907244	
15.0	6.7	9.5625	724.62	0.137053	92.362930	15.022443	
15.0	6.8	9.5625	578.74	0.172444	92.327515	11.937320	
15.0	6.9	9.5625	459.73	0.217048	92.282944	9.445401	
15.0	7.0	9.5625	365.14	0.273043	92.228944	7.539564	
15.0	7.1	9.5625	290.07	0.343560	92.165433	5.993133	
15.0	7.2	9.5625	230.41	0.432131	92.086756	4.744754	
15.0	7.3	9.5625	183.02	0.543412	92.005873	3.749020	
15.0	7.4	9.5625	145.34	0.684353	92.018333	3.013464	
15.0	7.5	9.5625	115.48	0.854514	92.014479	2.398314	
15.0	7.6	9.5625	91.73	1.074414	92.001585	1.904205	
15.0	7.7	9.5625	72.86	1.353454	92.004133	1.520436	
15.0	7.8	9.5625	57.88	1.698453	92.003544	1.212279	
15.0	7.9	9.5625	45.97	2.128460	92.001140	0.967184	
15.0	8.0	9.5625	36.52	2.665380	92.003610	0.772498	
15.0	8.1	9.5625	29.01	3.332511	92.007490	0.617452	
15.0	8.2	9.5625	23.04	4.154480	92.004500	0.445013	
15.0	8.3	9.5625	18.30	5.140674	92.001321	0.397438	
15.0	8.4	9.5625	14.54	6.435757	92.004240	0.319431	
15.0	8.5	9.5625	11.55	7.969327	92.003070	0.258366	
15.0	8.6	9.5625	9.17	9.829934	92.001700	0.204462	
15.0	8.7	9.5625	7.29	12.067445	92.003207	0.170417	
15.0	8.8	9.5625	5.79	14.732312	92.002654	0.139761	
15.0	8.9	9.5625	4.60	17.865347	92.001363	0.115251	
15.0	9.0	9.5625	3.65	21.446765	92.003235	0.095782	
15.0	9.1	9.5625	2.90	25.635495	92.004195	0.080317	
15.0	9.2	9.5625	2.30	30.264743	92.0073260	0.068033	
15.0	9.3	9.5625	1.83	35.332260	92.0067740	0.058275	
15.0	9.4	9.5625	1.45	40.752441	92.0047554	0.050525	
15.0	9.5	9.5625	1.15	46.607423	92.002575	0.044364	
15.0	9.6	9.5625	0.92	52.156326	92.0043674	0.039477	
15.0	9.7	9.5625	0.73	57.446643	92.0015137	0.035593	
15.0	9.8	9.5625	0.58	63.339767	92.0066233	0.032507	
15.0	9.9	9.5625	0.46	69.505085	92.0049995	0.030056	
15.0	10.0	9.5625	0.37	77.249447	92.00750153	0.028109	
15.0	10.1	9.5625	0.29	87.514450	92.0065550	0.026563	

.. CONCENTRATIONS OF AMMONIA (NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	PKA	RATIO	4 UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+ (M3)
15.5	5.0	9.5461	3512.93	0.302844	94.947147	724.025146
15.5	5.1	9.5461	27910.45	0.003540	94.946414	575.116452
15.5	5.2	9.5461	22140.37	0.004587	94.945443	456.431135
15.5	5.3	9.5461	17623.29	0.005574	94.944324	362.444033
15.5	5.4	9.5461	13498.76	0.007163	94.942844	244.251662
15.5	5.5	9.5461	11119.54	0.008992	94.940997	228.472717
15.5	5.6	9.5461	8832.61	0.011320	94.938674	181.443446
15.5	5.7	9.5461	7016.00	0.014251	94.935744	144.489026
15.5	5.8	9.5461	5573.01	0.017940	94.932054	114.764744
15.5	5.9	9.5461	4426.80	0.022585	94.927402	91.164488
15.5	6.0	9.5461	3516.34	0.028431	94.921554	72.422043
15.5	6.1	9.5461	2793.13	0.035784	94.914203	57.531204
15.5	6.2	9.5461	2218.67	0.045052	94.905941	45.702957
15.5	6.3	9.5461	1762.35	0.056710	94.896323	36.307434
15.5	6.4	9.5461	1394.69	0.071383	94.885604	24.544315
15.5	6.5	9.5461	1111.97	0.089844	94.910141	22.914107
15.5	6.6	9.5461	883.27	0.113087	94.886902	18.207169
15.5	6.7	9.5461	701.91	0.142327	94.857666	14.446721
15.5	6.8	9.5461	557.31	0.179112	94.820477	11.449572
15.5	6.9	9.5461	442.69	0.225344	94.774612	9.135502
15.5	7.0	9.5461	351.64	0.283575	94.716415	7.260435
15.5	7.1	9.5461	279.32	0.356734	94.643230	5.717139
15.5	7.2	9.5461	221.87	0.446042	94.551330	4.548491
15.5	7.3	9.5461	176.24	0.564214	94.435776	3.649325
15.5	7.4	9.5461	134.99	0.709266	94.290726	2.903001
15.5	7.5	9.5461	111.20	0.891276	94.108719	2.318171
15.5	7.6	9.5461	88.33	1.119464	94.020524	1.839272
15.5	7.7	9.5461	70.16	1.405247	94.544742	1.455222
15.5	7.8	9.5461	55.73	1.762683	94.237305	1.148104
15.5	7.9	9.5461	44.27	2.209003	97.790485	0.932094
15.5	8.0	9.5461	35.16	2.765151	97.234448	0.744624
15.5	8.1	9.5461	27.93	3.450384	96.543625	0.595712
15.5	8.2	9.5461	22.19	4.312709	95.647286	0.477426
15.5	8.3	9.5461	17.62	5.349413	94.630448	0.383448
15.5	8.4	9.5461	14.00	6.664944	93.332993	0.304835
15.5	8.5	9.5461	11.12	8.258407	91.749191	0.244551
15.5	8.6	9.5461	8.83	10.149873	89.630124	0.202461
15.5	8.7	9.5461	7.02	12.474604	87.525391	0.165055
15.5	8.8	9.5461	5.57	15.213197	84.746789	0.135343
15.5	8.9	9.5461	4.43	18.424422	81.573578	0.111742
15.5	9.0	9.5461	3.52	22.141094	77.458902	0.092944
15.5	9.1	9.5461	2.79	26.342610	73.637390	0.074103
15.5	9.2	9.5461	2.22	31.047453	64.932144	0.066274
15.5	9.3	9.5461	1.74	36.260053	54.799942	0.056878
15.5	9.4	9.5461	1.40	41.607547	54.332413	0.049415
15.5	9.5	9.5461	1.11	47.348053	52.651947	0.043486
15.5	9.6	9.5461	0.88	53.096038	44.901462	0.038777
15.5	9.7	9.5461	0.70	58.766891	41.233109	0.035037
15.5	9.8	9.5461	0.56	64.212418	35.747582	0.032065
15.5	9.9	9.5461	0.44	69.314270	30.687330	0.029705
15.5	10.0	9.5461	0.35	73.943475	26.016525	0.027631
15.5	10.1	9.5461	0.28	78.166016	21.833984	0.026341

** CONCENTRATIONS OF AMMONIA (NH4+ NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

Temp C	pH	pKa	RATIO	A UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+MH3
16.0	5.0	9.5297	33663.85	0.002953	99.997040	697.277100
15.0	5.1	9.5297	26899.05	0.003717	99.996277	553.471826
16.0	5.2	9.5297	21366.71	0.004600	99.995399	439.940937
16.0	5.3	9.5297	16972.20	0.005589	99.994411	349.478027
16.0	5.4	9.5297	13481.52	0.006717	99.993283	277.604980
16.0	5.5	9.5297	10708.77	0.008237	99.991763	220.514099
16.0	5.6	9.5297	8506.24	0.011752	99.988248	175.164864
16.0	5.7	9.5297	6756.79	0.016744	99.983255	139.142883
16.0	5.8	9.5297	5367.12	0.023451	99.976549	110.524510
16.0	5.9	9.5297	4251.26	0.032521	99.967476	87.801054
16.0	6.0	9.5297	3345.43	0.044774	99.955226	69.747208
16.0	6.1	9.5297	2699.94	0.060884	99.939115	55.406446
16.0	6.2	9.5297	2136.70	0.081120	99.918879	44.615244
16.0	6.3	9.5297	1697.24	0.093233	99.906769	36.946827
16.0	6.4	9.5297	1348.17	0.117420	99.882579	27.779434
16.0	6.5	9.5297	1070.89	0.145971	99.849029	22.070221
16.0	6.6	9.5297	850.54	0.177774	99.822214	17.535283
16.0	6.7	9.5297	675.69	0.230010	99.769976	13.933009
16.0	6.8	9.5297	536.72	0.294422	99.705506	11.071634
16.0	6.9	9.5297	425.12	0.370373	99.629623	8.798759
16.0	7.0	9.5297	334.54	0.465823	99.534164	6.933347
16.0	7.1	9.5297	269.99	0.585732	99.414261	5.559259
16.0	7.2	9.5297	213.67	0.736275	99.263718	4.20115
16.0	7.3	9.5297	169.73	0.925150	99.074844	3.251526
16.0	7.4	9.5297	134.81	1.161910	98.838049	2.795509
16.0	7.5	9.5297	107.09	1.453468	98.541426	2.225583
16.0	7.6	9.5297	85.07	1.825067	98.170429	1.611551
16.0	7.7	9.5297	67.57	2.291403	97.708191	1.125710
16.0	7.8	9.5297	53.67	2.868185	97.131805	0.898419
16.0	7.9	9.5297	42.63	3.544704	96.451587	0.717875
16.0	8.0	9.5297	33.67	4.370755	95.529236	0.574464
16.0	8.1	9.5297	26.90	5.363939	94.476050	0.460544
16.0	8.2	9.5297	21.37	6.540242	93.094844	0.370062
16.0	8.3	9.5297	16.97	7.916970	91.459702	0.298186
16.0	8.4	9.5297	13.48	9.414407	89.441018	0.241092
16.0	8.5	9.5297	10.71	11.051550	87.108521	0.195742
16.0	8.6	9.5297	8.51	12.704969	84.294846	0.159718
16.0	8.7	9.5297	6.76	14.408463	81.001007	0.131103
16.0	8.8	9.5297	5.37	16.094960	77.203140	0.104374
16.0	8.9	9.5297	4.24	17.694969	72.900131	0.080319
16.0	9.0	9.5297	3.39	19.179730	68.120270	0.075978
16.0	9.1	9.5297	2.69	20.734116	62.926044	0.065586
16.0	9.2	9.5297	2.14	22.345362	57.144454	0.055538
16.0	9.3	9.5297	1.70	24.027354	51.712646	0.046350
16.0	9.4	9.5297	1.35	25.773343	45.965452	0.038105
16.0	9.5	9.5297	1.07	27.575993	40.324005	0.0314503
16.0	9.6	9.5297	0.85	29.42754	34.927446	0.026401
16.0	9.7	9.5297	0.68	31.309070	29.690930	0.022369
16.0	9.8	9.5297	0.54	33.21192	25.298504	0.017563
16.0	9.9	9.5297	0.43	35.140166	21.198334	0.0126129
16.0	10.0	9.5297	0.34			
16.0	10.1	9.5297	0.27			

** CONCENTRATIONS OF AMMONIA (NH4+MH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	pH	pKa	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ ⁺ NH ₃ **
16.5	5.0	9.5134	32617.05	0.003046	99.996953	671.605713
16.5	5.1	9.5134	25908.08	0.003060	99.996939	533.440225
16.5	5.2	9.5134	20580.83	0.004859	99.995132	423.763428
16.5	5.3	9.5134	16347.12	0.006117	99.993881	336.611916
16.5	5.4	9.5134	12945.16	0.007701	99.992299	267.145016
16.5	5.5	9.5134	10314.49	0.009644	99.990356	212.385950
16.5	5.6	9.5134	8193.10	0.012204	99.987793	168.716431
16.5	5.7	9.5134	6508.02	0.015363	99.984634	134.020706
16.5	5.8	9.5134	5169.51	0.019340	99.980652	106.440754
16.5	5.9	9.5134	4106.29	0.024347	99.975657	84.569104
16.5	6.0	9.5134	3261.75	0.030644	99.969355	67.140023
16.5	6.1	9.5134	2590.96	0.038542	99.961451	53.367294
16.5	6.2	9.5134	2058.03	0.048567	99.951431	42.385447
16.5	6.3	9.5134	1634.75	0.061134	99.938854	33.640191
16.5	6.4	9.5134	1294.53	0.076951	99.923050	26.757370
16.5	6.5	9.5134	1031.46	0.094859	99.905137	21.259409
16.5	6.6	9.5134	819.32	0.121903	99.878092	16.890396
16.5	6.7	9.5134	650.81	0.153411	99.846573	13.420706
16.5	6.8	9.5134	516.96	0.193069	99.806931	10.644761
16.5	6.9	9.5134	410.64	0.243434	99.757065	8.475559
16.5	7.0	9.5134	326.18	0.305643	99.694351	6.734424
16.5	7.1	9.5134	259.09	0.384476	99.615524	5.355335
16.5	7.2	9.5134	205.81	0.483545	99.516459	4.258135
16.5	7.3	9.5134	163.46	0.607948	99.392014	3.346593
16.5	7.4	9.5134	129.86	0.764204	99.235794	2.694305
16.5	7.5	9.5134	103.15	0.940175	99.059825	2.144401
16.5	7.6	9.5134	81.93	1.205749	99.794205	1.707596
16.5	7.7	9.5134	65.04	1.513271	98.446725	1.340424
16.5	7.8	9.5134	51.70	1.897657	94.102341	1.045021
16.5	7.9	9.5134	41.06	2.377329	97.622865	0.845099
16.5	8.0	9.5134	32.62	2.974561	97.025436	0.692203
16.5	8.1	9.5134	25.91	3.716127	96.283859	0.554071
16.5	8.2	9.5134	20.58	4.633736	95.366257	0.444350
16.5	8.3	9.5134	16.35	5.764363	94.235626	0.357195
16.5	8.4	9.5134	12.99	7.150168	92.848823	0.287465
16.5	8.5	9.5134	10.31	8.837495	91.162094	0.232974
16.5	8.6	9.5134	8.19	10.877323	89.122665	0.189293
16.5	8.7	9.5134	6.51	13.318614	86.681381	0.154596
16.5	8.8	9.5134	5.17	16.204176	83.791824	0.127035
16.5	8.9	9.5134	4.11	19.543008	80.456992	0.105142
16.5	9.0	9.5134	3.24	23.443808	76.556194	0.087752
16.5	9.1	9.5134	2.59	27.847303	72.152695	0.073939
16.5	9.2	9.5134	2.06	32.899860	67.300140	0.062967
16.5	9.3	9.5134	1.63	37.953217	62.046783	0.054251
16.5	9.4	9.5134	1.30	43.504990	56.495010	0.047324
16.5	9.5	9.5134	1.03	49.224544	50.775436	0.041829
16.5	9.6	9.5134	0.82	54.964523	45.035477	0.037461
16.5	9.7	9.5134	0.65	60.575331	39.424667	0.033891
16.5	9.8	9.5134	0.52	65.920471	34.079529	0.031235
16.5	9.9	9.5134	0.41	70.899236	29.110764	0.029045
16.5	10.0	9.5134	0.33	75.493809	24.506191	0.027366
16.5	10.1	9.5134	0.26	79.421509	20.578491	0.025925

** CONCENTRATIONS OF AMMONIA (NH₄⁺ NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	pH	pKa	RATIO	μ UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ +NH ₃ μM
17.0	5.0	9.4972	31.20.19	0.003183	99.996817	646.941614
17.0	5.1	9.4972	29.57.47	0.004607	99.995393	513.405518
17.0	5.2	9.4972	19.62.43	0.005944	99.994056	408.213.67
17.0	5.3	9.4972	15.77.45	0.007444	99.992556	324.260.48
17.0	5.4	9.4972	12.50.66	0.010043	99.989957	257.573730
17.0	5.5	9.4972	9.36.00	0.012667	99.987333	204.502707
17.0	5.6	9.4972	7.82.45	0.015448	99.984552	162.525123
17.0	5.7	9.4972	6.29.21	0.018411	99.981589	129.103561
17.0	5.8	9.4972	4.97.82	0.022077	99.977923	102.554977
17.0	5.9	9.4972	3.95.61	0.025274	99.974726	81.456640
17.0	6.0	9.4972	3.12.06	0.031016	99.968984	64.715561
17.0	6.1	9.4972	2.45.63	0.040051	99.959949	51.407658
17.0	6.2	9.4972	1.94.51	0.050416	99.949584	40.440469
17.0	6.3	9.4972	1.57.77	0.061641	99.938359	32.445023
17.0	6.4	9.4972	1.25.88	0.074463	99.925537	25.776276
17.0	6.5	9.4972	.993.61	0.089444	99.899444	20.479080
17.0	6.6	9.4972	.787.26	0.105542	99.873458	16.271362
17.0	6.7	9.4972	.626.93	0.125254	99.840744	12.929064
17.0	6.8	9.4972	.497.99	0.150405	99.799591	10.274172
17.0	6.9	9.4972	.395.57	0.175216	99.747433	8.165305
17.0	7.0	9.4972	.314.21	0.211244	99.688734	6.480176
17.0	7.1	9.4972	.249.59	0.254064	99.600937	5.159573
17.0	7.2	9.4972	.190.25	0.301872	99.698123	4.102635
17.0	7.3	9.4972	.157.44	0.361094	99.368944	3.243076
17.0	7.4	9.4972	.125.09	0.433044	99.205499	2.596193
17.0	7.5	9.4972	.94.36	0.546286	99.003691	2.046467
17.0	7.6	9.4972	.78.93	0.701143	94.748850	1.655691
17.0	7.7	9.4972	.62.63	0.970012	94.029477	1.311454
17.0	7.8	9.4972	.49.80	1.294523	94.031464	1.045461
17.0	7.9	9.4972	.39.54	1.645652	97.534348	0.835073
17.0	8.0	9.4972	.31.42	2.044377	94.915619	0.687557
17.0	8.1	9.4972	.24.46	2.522230	94.147764	0.534445
17.0	8.2	9.4972	.19.63	3.017647	94.198227	0.426400
17.0	8.3	9.4972	.15.75	3.470824	94.029160	0.344463
17.0	8.4	9.4972	.12.51	4.023775	92.547610	0.276154
17.0	8.5	9.4972	.9.94	4.743778	90.856216	0.225180
17.0	8.6	9.4972	.7.89	5.550447	84.754913	0.183102
17.0	8.7	9.4972	.6.27	6.56176	84.243220	0.149676
17.0	8.8	9.4972	.4.94	7.722351	81.23124	0.123129
17.0	8.9	9.4972	.3.96	9.017467	79.621531	0.102039
17.0	9.0	9.4972	.3.14	10.41813	75.858185	0.085248
17.0	9.1	9.4972	.2.50	12.06660	71.345340	0.071961
17.0	9.2	9.4972	.1.98	13.927874	66.472122	0.061412
17.0	9.3	9.4972	.1.57	16.017474	61.162521	0.053016
17.0	9.4	9.4972	.1.25	18.425980	55.574020	0.046347
17.0	9.5	9.4972	.0.99	20.159134	49.840466	0.041049
17.0	9.6	9.4972	.0.79	22.044123	44.111177	0.036841
17.0	9.7	9.4972	.0.63	24.144504	38.535492	0.033499
17.0	9.8	9.4972	.0.50	26.55240	33.244720	0.030844
17.0	9.9	9.4972	.0.40	29.344674	24.345322	0.028735
17.0	10.0	9.4972	.0.31	32.600561	23.889439	0.027060
17.0	10.1	9.4972	.0.25	36.025816	19.974182	0.025724

•• CONCENTRATIONS OF AMMONIA(NH₄+NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.62 MG/L NH₃-N

TEMP C	pH	pKa	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION (M% NH3)
17.5	5.0	9.4810	30271.12	0.003103	99.996897	623.302736
17.5	5.1	9.4810	28045.24	0.004154	99.995846	485.112061
17.5	5.2	9.4810	19094.84	0.005235	99.994765	303.246133
17.5	5.3	9.4810	15171.56	0.006591	99.993409	312.403074
17.5	5.4	9.4810	12051.22	0.008297	99.991699	248.155106
17.5	5.5	9.4810	9572.43	0.010445	99.989554	197.121044
17.5	5.6	9.4810	7603.42	0.013150	99.986847	154.543206
17.5	5.7	9.4810	6039.94	0.016554	99.983445	124.382774
17.5	5.8	9.4810	4747.70	0.020834	99.979166	98.485206
17.5	5.9	9.4810	3810.95	0.026233	99.973755	74.681159
17.5	6.0	9.4810	3027.15	0.033023	99.966975	62.349670
17.5	6.1	9.4810	2404.56	0.041570	99.958429	49.530411
17.5	6.2	9.4810	1910.01	0.052328	99.947672	39.347702
17.5	6.3	9.4810	1517.16	0.065804	99.934128	31.259247
17.5	6.4	9.4810	1205.14	0.082493	99.917504	24.434366
17.5	6.5	9.4810	957.24	0.104354	99.895645	19.730894
17.5	6.6	9.4810	760.39	0.131336	99.868664	15.477076
17.5	6.7	9.4810	604.00	0.165284	99.834716	12.456995
17.5	6.8	9.4810	474.70	0.207997	99.791992	9.899187
17.5	6.9	9.4810	381.10	0.261711	99.738289	7.857455
17.5	7.0	9.4810	302.72	0.329241	99.670759	6.253582
17.5	7.1	9.4810	240.46	0.414144	99.585856	4.971436
17.5	7.2	9.4810	191.00	0.520824	99.479172	3.953351
17.5	7.3	9.4810	151.72	0.654794	99.345206	3.144498
17.5	7.4	9.4810	120.52	0.822941	99.177044	2.502002
17.5	7.5	9.4810	95.73	1.037816	98.960171	1.991649
17.5	7.6	9.4810	76.04	1.298021	98.701905	1.546760
17.5	7.7	9.4810	60.40	1.624636	97.371353	1.264247
17.5	7.8	9.4810	47.90	2.041718	97.954267	1.034464
17.5	7.9	9.4810	38.11	2.556051	97.443146	0.804287
17.5	8.0	9.4810	30.27	3.197714	96.802277	0.644097
17.5	8.1	9.4810	24.05	3.926020	96.07370	0.515701
17.5	8.2	9.4810	19.10	4.774972	95.225024	0.413472
17.5	8.3	9.4810	15.17	5.763463	94.236524	0.332985
17.5	8.4	9.4810	12.05	7.011833	93.016524	0.264735
17.5	8.5	9.4810	9.57	8.550033	90.541962	0.217694
17.5	8.6	9.4810	7.00	11.622317	88.377670	0.177159
17.5	8.7	9.4810	6.04	14.204145	85.795822	0.144957
17.5	8.8	9.4810	4.80	17.247635	82.752365	0.119379
17.5	8.9	9.4810	3.81	20.745217	79.254783	0.099061
17.5	9.0	9.4810	3.03	24.830673	75.169327	0.079102
17.5	9.1	9.4810	2.40	29.371536	70.628464	0.059419
17.5	9.2	9.4810	1.91	34.343205	65.656795	0.041830
17.5	9.3	9.4810	1.52	39.726044	60.273954	0.025405
17.5	9.4	9.4810	1.21	45.347610	54.652390	0.014301
17.5	9.5	9.4810	0.96	51.090378	48.909622	0.008247
17.5	9.6	9.4810	0.76	56.804504	43.195496	0.005307
17.5	9.7	9.4810	0.60	62.343094	37.656906	0.003307
17.5	9.8	9.4810	0.48	67.576854	32.423141	0.002469
17.5	9.9	9.4810	0.38	72.405212	27.594784	0.001837
17.5	10.0	9.4810	0.30	76.761740	23.238220	0.001423
17.5	10.1	9.4810	0.24	80.614070	19.385330	0.001141

CONCENTRATIONS OF AMMONIA (NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	pH	pKa	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ OH M	CONCENTRATION NH ₃ M
18.0	5.0	9.4649	29167.86	1.003423	99.996577	608.586670	
18.0	5.1	9.4649	23164.89	0.004231	99.995769	471.064354	
18.0	5.2	9.4649	18403.73	0.005433	99.994567	376.953369	
18.0	5.3	9.4649	14618.62	0.006943	99.993057	301.018066	
18.0	5.4	9.4649	11612.00	0.008911	99.991089	230.111710	
18.0	5.5	9.4649	9223.75	0.011840	99.988160	189.937592	
18.0	5.6	9.4649	7125.70	0.015647	99.984353	150.477182	
18.0	5.7	9.4649	5419.81	0.020716	99.979284	119.550433	
18.0	5.8	9.4649	4022.84	0.027225	99.972775	95.294461	
18.0	5.9	9.4649	3072.06	0.034272	99.965728	75.674326	
18.0	6.0	9.4649	2316.81	0.041342	99.958658	60.078033	
18.0	6.1	9.4649	1840.40	0.048307	99.951693	47.725983	
18.0	6.2	9.4649	1461.86	0.055139	99.944861	37.914383	
18.0	6.3	9.4649	1161.22	0.061835	99.938165	30.120743	
18.0	6.4	9.4649	922.39	0.068442	99.931558	23.470038	
18.0	6.5	9.4649	712.58	0.074977	99.925023	19.012543	
18.0	6.6	9.4649	541.99	0.081444	99.918556	15.166463	
18.0	6.7	9.4649	402.29	0.087851	99.912149	12.003737	
18.0	6.8	9.4649	307.21	0.094209	99.905791	9.519157	
18.0	6.9	9.4649	231.69	0.100520	99.899280	7.581466	
18.0	7.0	9.4649	184.04	0.106794	99.892706	6.026421	
18.0	7.1	9.4649	146.19	0.113033	99.886167	4.791196	
18.0	7.2	9.4649	116.12	0.119237	99.879663	3.810022	
18.0	7.3	9.4649	92.24	0.125408	99.873191	3.030444	
18.0	7.4	9.4649	71.25	0.131547	99.866753	2.411565	
18.0	7.5	9.4649	54.19	0.137646	99.860354	1.919812	
18.0	7.6	9.4649	40.22	0.143706	99.853999	1.521198	
18.0	7.7	9.4649	30.72	0.149726	99.847674	1.218422	
18.0	7.8	9.4649	23.17	0.155709	99.841381	0.972460	
18.0	7.9	9.4649	18.40	0.161652	99.835148	0.776689	
18.0	8.0	9.4649	14.61	0.167555	99.828965	0.621181	
18.0	8.1	9.4649	11.61	0.173418	99.822832	0.497657	
18.0	8.2	9.4649	9.22	0.179241	99.816759	0.399534	
18.0	8.3	9.4649	7.12	0.185024	99.810726	0.321400	
18.0	8.4	9.4649	5.41	0.190767	99.804753	0.259491	
18.0	8.5	9.4649	4.02	0.196470	99.798830	0.210515	
18.0	8.6	9.4649	3.07	0.202133	99.792967	0.171453	
18.0	8.7	9.4649	2.32	0.207756	99.787164	0.140425	
18.0	8.8	9.4649	1.84	0.213339	99.781421	0.115778	
18.0	8.9	9.4649	1.46	0.218882	99.775737	0.096201	
18.0	9.0	9.4649	1.16	0.224385	99.770115	0.080650	
18.0	9.1	9.4649	0.92	0.229848	99.764552	0.068297	
18.0	9.2	9.4649	0.73	0.235271	99.759049	0.058485	
18.0	9.3	9.4649	0.58	0.240654	99.753605	0.050691	
18.0	9.4	9.4649	0.46	0.245997	99.748222	0.044500	
18.0	9.5	9.4649	0.37	0.251299	99.742901	0.039583	
18.0	9.6	9.4649	0.29	0.256561	99.737640	0.035676	
18.0	9.7	9.4649	0.23	0.261783	99.732437	0.032574	
18.0	9.8	9.4649	0.19	0.266965	99.727291	0.030109	
18.0	9.9	9.4649	0.15	0.272107	99.722209	0.028151	
18.0	10.0	9.4649	0.12	0.277209	99.717181	0.026596	
18.0	10.1	9.4649	0.09	0.282271	99.712219	0.025361	

** CONCENTRATIONS OF AMMONIA(NH₄OH) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	PH	PRA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION mg/L NH3
14.5	5.0	9.4488	28108.34	0.003548	99.996451	578.771486
14.5	5.1	9.4488	22327.29	0.004474	99.995526	459.739502
14.5	5.2	9.4488	17735.21	0.005538	99.994462	365.144477
14.5	5.3	9.4488	14074.60	0.007334	99.992666	298.022229
14.5	5.4	9.4488	11143.19	0.009438	99.990562	238.026540
14.5	5.5	9.4488	8846.70	0.011244	98.988756	183.038495
14.5	5.6	9.4488	7068.55	0.014161	98.985839	145.397369
14.5	5.7	9.4488	5684.41	0.017427	98.982573	115.497549
14.5	5.8	9.4488	4554.42	0.022442	97.977558	91.747437
14.5	5.9	9.4488	3538.68	0.029251	97.070749	72.481912
14.5	6.0	9.4488	2810.87	0.035563	96.964437	57.444423
14.5	6.1	9.4488	2232.76	0.044476	95.955524	45.993057
14.5	6.2	9.4488	1773.55	0.056352	94.943648	36.533722
14.5	6.3	9.4488	1407.78	0.070933	92.920067	29.077359
14.5	6.4	9.4488	1114.03	0.092933	90.707067	23.061508
14.5	6.5	9.4488	884.68	0.112334	88.867666	18.122662
14.5	6.6	9.4488	706.85	0.141430	85.858565	14.558470
14.5	6.7	9.4488	568.44	0.177444	82.255556	11.544457
14.5	6.8	9.4488	455.45	0.223442	77.655558	9.193397
14.5	6.9	9.4488	353.87	0.281492	71.850508	7.306414
14.5	7.0	9.4488	281.09	0.354493	64.545507	5.808255
14.5	7.1	9.4488	223.28	0.458493	54.151507	4.617402
14.5	7.2	9.4488	177.36	0.580493	41.949507	3.672769
14.5	7.3	9.4488	140.44	0.704422	29.255577	2.921106
14.5	7.4	9.4488	111.91	0.857477	14.142544	2.324714
14.5	7.5	9.4488	88.49	1.045502	9.445495	1.850423
14.5	7.6	9.4488	70.61	1.271756	7.251916	1.474398
14.5	7.7	9.4488	56.89	1.544493	4.455507	1.175391
14.5	7.8	9.4488	45.55	1.873334	1.126666	0.937483
14.5	7.9	9.4488	35.39	2.244493	0.755507	0.749223
14.5	8.0	9.4488	28.11	2.666507	0.333493	0.599365
14.5	8.1	9.4488	22.33	3.173334	0.826666	0.480327
14.5	8.2	9.4488	17.74	3.773334	0.226666	0.345773
14.5	8.3	9.4488	14.09	4.477044	0.522844	0.310666
14.5	8.4	9.4488	11.19	5.203044	0.796956	0.251086
14.5	8.5	9.4488	8.89	6.042186	0.957814	0.203616
14.5	8.6	9.4488	7.06	7.045654	0.954345	0.155973
14.5	8.7	9.4488	5.61	8.117211	0.882711	0.134072
14.5	8.8	9.4488	4.46	9.315151	0.684849	0.112321
14.5	8.9	9.4488	3.54	10.632160	0.367834	0.093454
14.5	9.0	9.4488	2.81	12.239914	0.760086	0.074468
14.5	9.1	9.4488	2.23	14.032434	0.967566	0.065544
14.5	9.2	9.4488	1.77	16.053970	0.946206	0.057189
14.5	9.3	9.4488	1.41	18.317794	0.949723	0.049598
14.5	9.4	9.4488	1.12	20.940353	0.959647	0.043632
14.5	9.5	9.4488	0.89	24.060781	0.964581	0.038693
14.5	9.6	9.4488	0.71	27.813414	0.965414	0.035126
14.5	9.7	9.4488	0.56	32.205714	0.965714	0.032138
14.5	9.8	9.4488	0.45	37.361420	0.965840	0.029763
14.5	9.9	9.4488	0.35	43.057745	0.965840	0.027877
14.5	10.0	9.4488	0.24	49.746918	0.965840	0.026376
14.5	10.1	9.4488	0.22	57.746918	0.965840	0.025187

CONCENTRATIONS OF AMMONIA (NH4+NH3) WHICH CONTAIN AN UNIONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-M

TEMP C	pH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ ⁺ NH ₃ **
19.0	5.0	9.4328	2709.77	0.003691	99.996307	557.819336
19.0	5.1	9.4328	21514.99	0.006667	99.993333	443.094436
19.0	5.2	9.4328	17043.15	0.008653	99.991347	351.44750
19.0	5.3	9.4328	13577.59	0.0097365	99.9902635	276.543252
19.0	5.4	9.4328	10765.08	0.009271	99.990729	222.045666
19.0	5.5	9.4328	8566.51	0.008471	99.991529	176.411147
19.0	5.6	9.4328	6864.95	0.007493	99.992507	140.134430
19.0	5.7	9.4328	5495.37	0.006497	99.993503	111.317134
19.0	5.8	9.4328	4293.64	0.005324	99.994676	84.626727
19.0	5.9	9.4328	3410.57	0.004312	99.995688	70.244171
19.0	6.0	9.4328	2769.11	0.003494	99.996506	55.401193
19.0	6.1	9.4328	2151.93	0.002844	99.997156	44.326766
19.0	6.2	9.4328	1704.34	0.002349	99.997651	35.215666
19.0	6.3	9.4328	1357.74	0.001959	99.998041	27.777236
19.0	6.4	9.4328	1076.52	0.001633	99.998367	22.277371
19.0	6.5	9.4328	856.70	0.001359	99.998641	17.60095
19.0	6.6	9.4328	686.50	0.001159	99.998841	14.32166
19.0	6.7	9.4328	549.54	0.000957	99.999043	11.150195
19.0	6.8	9.4328	429.37	0.000734	99.999266	8.451320
19.0	6.9	9.4328	341.06	0.000532	99.999468	7.041934
19.0	7.0	9.4328	276.91	0.000362	99.999638	5.59725
19.0	7.1	9.4328	215.20	0.000254	99.999746	4.451468
19.0	7.2	9.4328	170.76	0.000161	99.999839	3.540167
19.0	7.3	9.4328	135.78	0.000110	99.999890	2.816294
19.0	7.4	9.4328	107.85	0.000064	99.999936	2.241300
19.0	7.5	9.4328	85.67	0.000042	99.999958	1.744565
19.0	7.6	9.4328	68.05	0.000027	99.999973	1.421767
19.0	7.7	9.4328	54.04	0.000016	99.999984	1.133585
19.0	7.8	9.4328	42.94	0.000009	99.999991	0.904674
19.0	7.9	9.4328	34.11	0.000005	99.999995	0.722844
19.0	8.0	9.4328	27.09	0.000003	99.999997	0.578411
19.0	8.1	9.4328	21.52	0.000002	99.999998	0.463684
19.0	8.2	9.4328	17.09	0.000001	99.999999	0.372553
19.0	8.3	9.4328	13.58	0.000000	99.999999	0.309164
19.0	8.4	9.4328	10.79	0.000000	99.999999	0.262664
19.0	8.5	9.4328	8.57	0.000000	99.999999	0.16990
19.0	8.6	9.4328	6.81	0.000000	99.999999	0.10710
19.0	8.7	9.4328	5.41	0.000000	99.999999	0.11191
19.0	8.8	9.4328	4.29	0.000000	99.999999	0.10300
19.0	8.9	9.4328	3.41	0.000000	99.999999	0.090816
19.0	9.0	9.4328	2.71	0.000000	99.999999	0.076173
19.0	9.1	9.4328	2.15	0.000000	99.999999	0.064900
19.0	9.2	9.4328	1.71	0.000000	99.999999	0.055787
19.0	9.3	9.4328	1.36	0.000000	99.999999	0.048548
19.0	9.4	9.4328	1.04	0.000000	99.999999	0.042798
19.0	9.5	9.4328	0.86	0.000000	99.999999	0.038230
19.0	9.6	9.4328	0.68	0.000000	99.999999	0.034402
19.0	9.7	9.4328	0.54	0.000000	99.999999	0.031720
19.0	9.8	9.4328	0.43	0.000000	99.999999	0.029431
19.0	9.9	9.4328	0.34	0.000000	99.999999	0.027613
19.0	10.0	9.4328	0.27	0.000000	99.999999	0.026168
19.0	10.1	9.4328	0.22	0.000000	99.999999	0.025021

** CONCENTRATIONS OF AMMONIA (NH₄⁺ NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+MH3 **
19.5	5.0	9.4169	2611.29	0.003029	99.996970	537.491115
19.5	5.1	9.4169	20742.55	0.004421	99.995579	427.109619
19.5	5.2	9.4169	16476.42	0.006069	99.993930	339.270620
19.5	5.3	9.4169	13047.70	0.007640	99.992355	269.543319
19.5	5.4	9.4169	10395.94	0.009216	99.990784	216.072401
19.5	5.5	9.4169	8257.80	0.011804	99.988196	170.044515
19.5	5.6	9.4169	6559.41	0.015243	99.984756	135.079412
19.5	5.7	9.4169	5210.33	0.019149	99.980850	107.301224
19.5	5.8	9.4169	4138.72	0.024156	99.975843	85.236493
19.5	5.9	9.4169	3261.51	0.030409	99.969590	67.710373
19.5	6.0	9.4169	2611.36	0.038279	99.961721	53.748574
19.5	6.1	9.4169	2074.28	0.048146	99.951853	42.730072
19.5	6.2	9.4169	1647.66	0.060655	99.939345	33.945953
19.5	6.3	9.4169	1304.79	0.076348	99.923652	26.944521
19.5	6.4	9.4169	1039.61	0.096094	99.903906	21.426117
19.5	6.5	9.4169	825.79	0.120950	99.879049	17.023621
19.5	6.6	9.4169	655.95	0.152219	99.847778	13.476400
19.5	6.7	9.4169	521.04	0.191550	99.808441	10.76416
19.5	6.8	9.4169	413.88	0.241035	99.758957	8.542335
19.5	6.9	9.4169	326.76	0.304252	99.695732	6.749660
19.5	7.0	9.4169	261.14	0.381475	99.618515	5.307465
19.5	7.1	9.4169	207.43	0.479775	99.520218	4.291545
19.5	7.2	9.4169	164.77	0.603251	99.396748	3.413175
19.5	7.3	9.4169	130.44	0.756262	99.243730	2.715419
19.5	7.4	9.4169	103.96	0.952724	99.047272	2.161172
19.5	7.5	9.4169	82.58	1.196454	98.803543	1.729918
19.5	7.6	9.4169	65.50	1.501549	98.498398	1.371210
19.5	7.7	9.4169	52.10	1.883064	98.116928	1.033627
19.5	7.8	9.4169	41.39	2.359133	97.640954	0.812776
19.5	7.9	9.4169	32.88	2.951945	97.048050	0.697506
19.5	8.0	9.4169	26.11	3.688086	96.311905	0.558284
19.5	8.1	9.4169	20.74	4.590958	95.400944	0.447694
19.5	8.2	9.4169	16.44	5.721774	94.278214	0.359453
19.5	8.3	9.4169	13.09	7.098123	92.931811	0.290077
19.5	8.4	9.4169	10.40	8.774726	91.225265	0.234651
19.5	8.5	9.4169	8.26	10.801306	89.198655	0.190425
19.5	8.6	9.4169	6.56	13.228066	86.771927	0.155654
19.5	8.7	9.4169	5.21	16.101639	83.894361	0.127875
19.5	8.8	9.4169	4.14	19.459457	80.540541	0.105810
19.5	8.9	9.4169	3.29	23.322845	76.677155	0.084283
19.5	9.0	9.4169	2.61	27.640545	72.359455	0.073360
19.5	9.1	9.4169	2.07	32.526993	67.473037	0.063301
19.5	9.2	9.4169	1.65	37.768173	62.231827	0.054517
19.5	9.3	9.4169	1.31	43.311754	56.688244	0.047539
19.5	9.4	9.4169	1.04	49.027985	50.972015	0.041946
19.5	9.5	9.4169	0.83	54.749780	45.250240	0.037594
19.5	9.6	9.4169	0.66	60.387294	39.612701	0.034097
19.5	9.7	9.4169	0.52	65.743530	34.256470	0.031319
19.5	9.8	9.4169	0.41	70.726624	29.273376	0.029112
19.5	9.9	9.4169	0.33	75.257624	24.742371	0.027359
19.5	10.0	9.4169	0.26	79.292674	20.707321	0.025967
19.5	10.1	9.4169	0.21	82.619885	17.380115	0.024461

** CONCENTRATIONS OF AMMONIA (NH4+MH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-M

Temp C	pH	pKa	RATIO	UNIONIZED AMMONIA	% UNIONIZED AMMONIA	CONCENTRATION NH ₄ OH **
20.0	5.0	9.4010	25176.29	0.003972	94.496317	518.359375
20.0	5.1	9.4010	19496.68	0.005001	94.944995	411.752197
20.0	5.2	9.4010	15441.93	0.006243	94.493698	327.070557
20.0	5.3	9.4010	12617.07	0.007925	94.942665	259.465152
20.0	5.4	9.4010	10022.11	0.009977	94.940021	206.375885
20.0	5.5	9.4010	7960.86	0.012560	94.947427	163.934001
20.0	5.6	9.4010	6323.54	0.015811	94.944177	130.227321
20.0	5.7	9.4010	5022.94	0.019905	94.940047	103.443619
20.0	5.8	9.4010	3944.90	0.025057	94.974430	82.172592
20.0	5.9	9.4010	3168.29	0.031543	94.968445	65.276337
20.0	6.0	9.4010	2517.46	0.039707	94.960241	51.655103
20.0	6.1	9.4010	1994.69	0.049943	94.950012	41.194250
20.0	6.2	9.4010	1588.82	0.062910	94.937373	32.726044
20.0	6.3	9.4010	1261.72	0.079194	94.920037	25.995112
20.0	6.4	9.4010	1002.23	0.099674	94.903314	20.656367
20.0	6.5	9.4010	796.10	0.125655	94.874542	16.122116
20.0	6.6	9.4010	632.36	0.157887	94.842122	13.040848
20.0	6.7	9.4010	502.30	0.194867	94.801100	10.343042
20.0	6.8	9.4010	394.91	0.250003	94.749955	8.235901
20.0	6.9	9.4010	316.41	0.314531	94.684555	6.546247
20.0	7.0	9.4010	251.75	0.375643	94.604340	5.204113
20.0	7.1	9.4010	199.97	0.447562	94.502411	4.138015
20.0	7.2	9.4010	158.84	0.525611	94.373390	3.291182
20.0	7.3	9.4010	126.17	0.624611	94.213669	2.514517
20.0	7.4	9.4010	100.22	0.746323	94.012045	2.044199
20.0	7.5	9.4010	79.61	0.847904	94.754566	1.654776
20.0	7.6	9.4010	63.24	1.024024	94.443268	1.322643
20.0	7.7	9.4010	50.23	1.556730	94.443268	1.054449
20.0	7.8	9.4010	39.90	1.951934	94.040050	0.842132
20.0	7.9	9.4010	31.69	2.444984	97.555008	0.673165
20.0	8.0	9.4010	25.14	3.058684	96.441315	0.516950
20.0	8.1	9.4010	20.00	3.820344	96.174596	0.432338
20.0	8.2	9.4010	15.98	4.762475	95.237314	0.347654
20.0	8.3	9.4010	12.62	5.922563	94.077423	0.280386
20.0	8.4	9.4010	10.02	7.343443	92.656555	0.226954
20.0	8.5	9.4010	7.96	9.072324	90.927654	0.184511
20.0	8.6	9.4010	6.32	11.154234	84.840754	0.150797
20.0	8.7	9.4010	5.02	13.644114	86.345856	0.124017
20.0	8.8	9.4010	3.99	16.602524	83.347476	0.102785
20.0	8.9	9.4010	3.17	20.034825	79.960175	0.085464
20.0	9.0	9.4010	2.52	23.944131	76.015669	0.072427
20.0	9.1	9.4010	2.00	28.424741	71.571259	0.061765
20.0	9.2	9.4010	1.59	33.334000	64.664200	0.053247
20.0	9.3	9.4010	1.26	34.025550	61.367310	0.046570
20.0	9.4	9.4010	1.00	44.213013	55.746997	0.041227
20.0	9.5	9.4010	0.80	49.943340	50.056610	0.036982
20.0	9.6	9.4010	0.63	55.675278	44.324722	0.033611
20.0	9.7	9.4010	0.50	61.259903	38.740097	0.030933
20.0	9.8	9.4010	0.43	66.563477	33.436523	0.028466
20.0	9.9	9.4010	0.32	71.470034	28.520946	0.027116
20.0	10.0	9.4010	0.25	75.932443	24.066757	0.025774
20.0	10.1	9.4010	0.20	79.447543	20.112457	0.024708
20.0				83.334732	16.665264	

** CONCENTRATIONS OF AMMONIA(NH₄+NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ ⁺ M3
20.5	5.0	9.3851	26272.02	0.084120	99.995880	499.781494
20.5	5.1	9.3851	19276.97	0.005165	99.994835	396.995361
20.5	5.2	9.3851	15314.65	0.004524	99.995476	315.349121
20.5	5.3	9.3851	12164.48	0.004220	99.995780	250.495422
20.5	5.4	9.3851	9662.52	0.010344	99.989656	196.940042
20.5	5.5	9.3851	7675.54	0.013027	99.986973	156.054467
20.5	5.6	9.3851	6090.91	0.016349	99.983651	125.555493
20.5	5.7	9.3851	4842.95	0.020644	99.979355	99.737000
20.5	5.8	9.3851	3840.90	0.025984	99.973994	79.224195
20.5	5.9	9.3851	3055.70	0.032715	99.967285	62.537515
20.5	6.0	9.3851	2427.23	0.041142	99.958857	49.997345
20.5	6.1	9.3851	1929.02	0.051440	99.948560	39.714597
20.5	6.2	9.3851	1531.49	0.062553	99.937447	31.553879
20.5	6.3	9.3851	1216.50	0.074213	99.925787	25.064805
20.5	6.4	9.3851	966.51	0.087340	99.912660	19.916824
20.5	6.5	9.3851	767.56	0.101113	99.898887	15.824747
20.5	6.6	9.3851	609.70	0.116374	99.883624	12.574297
20.5	6.7	9.3851	484.30	0.133477	99.866323	9.942354
20.5	6.8	9.3851	384.70	0.152472	99.847523	7.941461
20.5	6.9	9.3851	305.57	0.173613	99.826387	6.312364
20.5	7.0	9.3851	242.73	0.197185	99.802815	5.018335
20.5	7.1	9.3851	192.81	0.223293	99.776707	3.990446
20.5	7.2	9.3851	153.15	0.251942	99.748058	3.173463
20.5	7.3	9.3851	121.65	0.283173	99.716827	2.525407
20.5	7.4	9.3851	96.63	0.317314	99.682686	2.010242
20.5	7.5	9.3851	76.76	0.354255	99.645745	1.601027
20.5	7.6	9.3851	60.97	0.394050	99.605950	1.275476
20.5	7.7	9.3851	48.43	0.436655	99.563322	1.017760
20.5	7.8	9.3851	38.47	0.482367	99.518631	0.812688
20.5	7.9	9.3851	30.56	0.531567	99.471287	0.649777
20.5	8.0	9.3851	24.27	0.583787	99.421207	0.520372
20.5	8.1	9.3851	19.28	0.639774	99.368214	0.417581
20.5	8.2	9.3851	15.32	0.699224	99.312773	0.335932
20.5	8.3	9.3851	12.17	0.762674	99.254312	0.271075
20.5	8.4	9.3851	9.66	0.829950	99.192040	0.219558
20.5	8.5	9.3851	7.64	0.899745	99.126836	0.178636
20.5	8.6	9.3851	6.10	0.971544	99.058130	0.146130
20.5	8.7	9.3851	4.84	1.046015	98.985956	0.120310
20.5	8.8	9.3851	3.85	1.114044	98.909836	0.099401
20.5	8.9	9.3851	3.06	1.176107	98.829827	0.083510
20.5	9.0	9.3851	2.43	1.232244	98.746147	0.070569
20.5	9.1	9.3851	1.93	1.282630	98.659206	0.060290
20.5	9.2	9.3851	1.53	1.327170	98.569505	0.052125
20.5	9.3	9.3851	1.22	1.366145	98.477355	0.045639
20.5	9.4	9.3851	0.97	1.400154	98.382826	0.040487
20.5	9.5	9.3851	0.77	1.429935	98.286363	0.036395
20.5	9.6	9.3851	0.61	1.455774	98.187944	0.033144
20.5	9.7	9.3851	0.48	1.478237	98.087663	0.030462
20.5	9.8	9.3851	0.38	1.497934	97.985520	0.028511
20.5	9.9	9.3851	0.31	1.515270	97.881630	0.026882
20.5	10.0	9.3851	0.24	1.530903	97.776097	0.025588
20.5	10.1	9.3851	0.19	1.545460	97.668940	0.024560
20.5	10.1	9.3851	0.14	1.558534	97.560534	0.023760

** CONCENTRATIONS OF AMMONIA (NH₄-NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	pH	pKa	RATIO	% UN-IONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₃ (M)
21.0	5.0	9.3693	23405.03	7.004272	99.995728	461.918174
21.0	5.1	9.3693	15551.30	3.0053174	99.9946826	382.415430
21.0	5.2	9.3693	14767.62	0.600771	99.9932285	306.085693
21.0	5.3	9.3693	11730.45	0.007524	99.992475	241.548534
21.0	5.4	9.3693	9317.77	0.010731	99.989268	191.073352
21.0	5.5	9.3693	7401.37	0.013509	99.986491	152.614486
21.0	5.6	9.3693	5874.13	0.017005	99.982995	121.071804
21.0	5.7	9.3693	4664.36	0.021404	99.978596	96.175156
21.0	5.8	9.3693	3764.49	0.026951	99.973049	76.394926
21.0	5.9	9.3693	2966.55	0.033926	99.966074	60.590140
21.0	6.0	9.3693	2340.54	0.042707	99.957291	48.212206
21.0	6.1	9.3693	1859.16	0.053759	99.946244	38.300594
21.0	6.2	9.3693	1476.77	0.067669	99.932327	30.427551
21.0	6.3	9.3693	1173.05	0.085175	99.914825	24.173721
21.0	6.4	9.3693	931.79	0.117205	99.882795	19.206116
21.0	6.5	9.3693	740.15	0.134926	99.865074	15.240231
21.0	6.6	9.3693	587.41	0.165062	99.834938	12.125445
21.0	6.7	9.3693	466.43	0.213674	99.786326	9.636169
21.0	6.8	9.3693	376.45	0.258851	99.741149	7.658524
21.0	6.9	9.3693	296.66	0.305444	99.694556	6.047627
21.0	7.0	9.3693	234.06	0.354993	99.645007	4.819418
21.0	7.1	9.3693	185.92	0.407354	99.592646	3.864444
21.0	7.2	9.3693	147.67	0.462520	99.537480	3.061326
21.0	7.3	9.3693	117.31	0.521173	99.478827	2.435915
21.0	7.4	9.3693	93.14	0.583305	99.416695	1.939172
21.0	7.5	9.3693	74.01	0.649240	99.350760	1.544574
21.0	7.6	9.3693	58.79	0.720436	99.279564	1.231135
21.0	7.7	9.3693	46.62	0.797304	99.202696	0.972161
21.0	7.8	9.3693	37.61	0.880454	99.119546	0.784395
21.0	7.9	9.3693	29.67	0.970354	99.029646	0.627302
21.0	8.0	9.3693	23.41	0.104162	98.945838	0.502519
21.0	8.1	9.3693	18.59	0.341888	98.858112	0.403400
21.0	8.2	9.3693	14.77	0.545944	98.764064	0.324464
21.0	8.3	9.3693	11.73	0.697165	98.663119	0.262124
21.0	8.4	9.3693	9.32	0.812340	98.556881	0.212451
21.0	8.5	9.3693	7.40	0.903621	98.443379	0.172490
21.0	8.6	9.3693	5.88	0.976201	98.323800	0.141646
21.0	8.7	9.3693	4.67	0.103332	98.200474	0.110744
21.0	8.8	9.3693	3.71	0.337764	98.072231	0.084472
21.0	8.9	9.3693	2.95	0.534440	97.938552	0.068746
21.0	9.0	9.3693	2.34	0.697441	97.800449	0.058472
21.0	9.1	9.3693	1.86	0.833979	97.658589	0.050946
21.0	9.2	9.3693	1.48	0.941712	97.512744	0.044744
21.0	9.3	9.3693	1.17	0.102528	97.363592	0.039774
21.0	9.4	9.3693	0.93	0.165294	97.212768	0.035430
21.0	9.5	9.3693	0.74	0.234634	97.060361	0.032696
21.0	9.6	9.3693	0.59	0.317672	96.906702	0.030206
21.0	9.7	9.3693	0.47	0.411116	96.752484	0.028228
21.0	9.8	9.3693	0.37	0.513634	96.597361	0.026657
21.0	9.9	9.3693	0.29	0.623924	96.441702	0.025409
21.0	10.0	9.3693	0.23	0.742237	96.276773	0.024418
21.0	10.1	9.3693	0.19			

** CONCENTRATIONS OF AMMONIA (NH₃+NH₄⁺) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	pH	pKa	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4-NH3
21.5	5.0	9.3536	22571.74	0.004430	99.995560	444.773482
21.5	5.1	9.3536	17929.43	0.005577	99.994423	369.187500
21.5	5.2	9.3536	14241.87	0.007021	99.992979	293.760742
21.5	5.3	9.3536	11316.74	0.008839	99.991161	232.469421
21.5	5.4	9.3536	8946.04	0.011127	98.988873	185.363137
21.5	5.5	9.3536	7137.89	0.014004	98.985996	146.949532
21.5	5.6	9.3536	5669.63	0.017634	98.982366	116.762253
21.5	5.7	9.3536	4503.71	0.022199	98.977801	92.751944
21.5	5.8	9.3536	3577.43	0.027965	98.972035	73.477779
21.5	5.9	9.3536	2841.65	0.035174	98.964826	58.510243
21.5	6.0	9.3536	2257.21	0.044243	98.955757	46.440521
21.5	6.1	9.3536	1792.97	0.055742	98.944258	36.937790
21.5	6.2	9.3536	1424.21	0.070162	98.929838	29.365016
21.5	6.3	9.3536	1131.29	0.088317	98.911683	23.313843
21.5	6.4	9.3536	894.62	0.111154	98.888846	18.536317
21.5	6.5	9.3536	713.90	0.139400	98.860599	14.717480
21.5	6.6	9.3536	566.99	0.176059	98.823941	11.694914
21.5	6.7	9.3536	450.34	0.221544	98.778456	9.293844
21.5	6.8	9.3536	357.75	0.278747	98.721253	7.386613
21.5	6.9	9.3536	284.17	0.350669	98.649331	5.871639
21.5	7.0	9.3536	225.72	0.441065	98.558935	4.668244
21.5	7.1	9.3536	179.30	0.546333	98.453667	3.712362
21.5	7.2	9.3536	142.42	0.674240	98.325760	2.953073
21.5	7.3	9.3536	113.13	0.831190	98.168810	2.364547
21.5	7.4	9.3536	89.46	1.005599	98.994401	1.870467
21.5	7.5	9.3536	71.38	1.341583	98.658417	1.490318
21.5	7.6	9.3536	56.70	1.733109	98.266891	1.180038
21.5	7.7	9.3536	45.04	2.172104	97.827896	0.949229
21.5	7.8	9.3536	35.78	2.719219	97.280777	0.757203
21.5	7.9	9.3536	28.42	3.349357	96.650632	0.605703
21.5	8.0	9.3536	22.57	4.262190	95.737777	0.485762
21.5	8.1	9.3536	17.93	5.242571	94.757777	0.389772
21.5	8.2	9.3536	14.24	6.506617	93.493377	0.313842
21.5	8.3	9.3536	11.31	8.121360	91.876632	0.253529
21.5	8.4	9.3536	8.99	10.013612	89.983374	0.205620
21.5	8.5	9.3536	7.14	12.247779	87.752219	0.167565
21.5	8.6	9.3536	5.67	14.942370	85.057614	0.137336
21.5	8.7	9.3536	4.50	18.104961	81.895039	0.113325
21.5	8.8	9.3536	3.58	21.845627	78.154373	0.094252
21.5	8.9	9.3536	2.94	26.029649	73.970352	0.079102
21.5	9.0	9.3536	2.26	30.700241	69.299759	0.067064
21.5	9.1	9.3536	1.79	35.803253	64.196747	0.057509
21.5	9.2	9.3536	1.42	41.249583	58.750417	0.049916
21.5	9.3	9.3536	1.13	46.918915	53.081085	0.043884
21.5	9.4	9.3536	0.90	52.669913	47.330087	0.039093
21.5	9.5	9.3536	0.71	58.440669	41.559331	0.035208
21.5	9.6	9.3536	0.57	63.815674	36.184326	0.032265
21.5	9.7	9.3536	0.45	68.466701	31.533294	0.029864
21.5	9.8	9.3536	0.36	73.505289	26.494711	0.027954
21.5	9.9	9.3536	0.28	77.870651	22.129349	0.026441
21.5	10.0	9.3536	0.23	81.583847	18.416153	0.025238
21.5	10.1	9.3536	0.18	84.795624	15.204376	0.024282

** CONCENTRATIONS OF AMMONIA (NH4-NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	PKA	RATIO	3. UNIONIZED AMMONIA	3. IONIZED AMMONIA	CONCENTRATION NH ₄ ⁺ NH ₃ **
22.0	5.0	9.3379	2170.85	0.00593	90.995407	44.282471
22.0	5.1	9.3379	1723.22	0.007742	90.994217	356.047691
22.0	5.2	9.3379	1375.22	0.010277	90.992722	242.455225
22.0	5.3	9.3379	1041.12	0.013616	90.990829	224.74416
22.0	5.4	9.3379	8067.17	0.01837	90.988466	176.477661
22.0	5.5	9.3379	6084.59	0.02523	90.98576	141.774261
22.0	5.6	9.3379	5084.63	0.03463	90.9821705	112.614675
22.0	5.7	9.3379	4343.49	0.048016	90.976974	89.461340
22.0	5.8	9.3379	3850.44	0.06772	90.971024	71.064055
22.0	5.9	9.3379	2740.82	0.104672	90.963514	56.454046
22.0	6.0	9.3379	2177.11	0.164911	90.956066	44.447366
22.0	6.1	9.3379	1724.35	0.277742	90.947200	35.627423
22.0	6.2	9.3379	1373.67	0.477742	90.937246	24.104443
22.0	6.3	9.3379	1041.15	0.81763	90.926432	22.447274
22.0	6.4	9.3379	806.73	1.15243	90.914750	17.466531
22.0	6.5	9.3379	608.47	1.64034	90.89450	14.156157
22.0	6.6	9.3379	508.47	2.162525	90.871474	11.240662
22.0	6.7	9.3379	434.40	3.224676	90.8470325	4.954744
22.0	6.8	9.3379	385.05	5.24473	90.811014	7.125235
22.0	6.9	9.3379	274.09	9.363523	90.636475	5.564020
22.0	7.0	9.3379	217.71	16.57217	90.542770	4.503330
22.0	7.1	9.3379	172.94	25.74921	90.425674	3.511359
22.0	7.2	9.3379	137.37	40.722706	90.277293	2.449413
22.0	7.3	9.3379	104.12	60.908132	90.091458	2.247290
22.0	7.4	9.3379	80.67	1.140547	90.059406	1.752210
22.0	7.5	9.3379	60.85	1.431644	90.568314	1.36167
22.0	7.6	9.3379	54.69	1.795724	90.204259	1.146612
22.0	7.7	9.3379	43.44	2.616441	90.749771	0.315023
22.0	7.8	9.3379	34.51	3.520014	97.143548	0.731564
22.0	7.9	9.3379	27.41	4.341410	90.474480	0.58440
22.0	8.0	9.3379	21.77	5.444293	90.608582	0.66870
22.0	8.1	9.3379	17.29	6.745084	90.533707	0.376472
22.0	8.2	9.3379	13.74	8.145084	93.214346	0.303436
22.0	8.3	9.3379	10.91	9.345085	91.604435	0.245263
22.0	8.4	9.3379	8.67	10.343402	89.656097	0.190554
22.0	8.5	9.3379	6.44	12.042503	87.317440	0.162350
22.0	8.6	9.3379	5.47	15.44677	84.541321	0.133194
22.0	8.7	9.3379	4.34	14.712311	81.247684	0.110034
22.0	8.8	9.3379	3.45	22.468753	77.531250	0.091638
22.0	8.9	9.3379	2.74	26.731304	71.248642	0.077026
22.0	9.0	9.3379	2.18	31.474213	62.525747	0.065419
22.0	9.1	9.3379	1.73	35.637443	63.362152	0.056199
22.0	9.2	9.3379	1.37	42.127633	57.872162	0.048475
22.0	9.3	9.3379	1.09	47.819626	52.140374	0.043058
22.0	9.4	9.3379	0.87	53.554604	44.431394	0.038437
22.0	9.5	9.3379	0.69	59.224274	40.775726	0.034766
22.0	9.6	9.3379	0.55	64.645706	35.354244	0.031851
22.0	9.7	9.3379	0.43	69.714920	30.265080	0.029535
22.0	9.8	9.3379	0.35	74.345734	24.654266	0.027695
22.0	9.9	9.3379	0.27	78.486944	21.513016	0.026234
22.0	10.0	9.3379	0.22	82.120483	17.879517	0.025073
22.0	10.1	9.3379	0.17	85.255554	14.744446	0.024151

** CONCENTRATIONS OF AMMONIA (NH₄⁺ NH₃) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4-NH3 **
22.5	5.0	9.1222	21000.95	0.004761	99.995239	432.430176
22.5	5.1	9.1222	16861.67	0.005994	99.994003	343.496094
22.5	5.2	9.1222	13259.73	0.007547	99.992457	272.851027
22.5	5.3	9.1222	10525.45	0.009500	99.990494	216.736456
22.5	5.4	9.1222	8360.67	0.011954	99.988047	172.146624
22.5	5.5	9.1222	6661.12	0.015053	99.984940	136.761276
22.5	5.6	9.1222	5275.24	0.018953	99.981043	108.537662
22.5	5.7	9.1222	4190.28	0.023854	99.976135	86.294477
22.5	5.8	9.1222	3298.46	0.030035	99.969955	68.553619
22.5	5.9	9.1222	2643.90	0.037804	99.962199	54.458389
22.5	6.0	9.1222	2100.12	0.047594	99.952393	43.262131
22.5	6.1	9.1222	1686.19	0.059904	99.940094	34.366591
22.5	6.2	9.1222	1325.09	0.075410	99.924591	27.304230
22.5	6.3	9.1222	1052.56	0.094916	99.905075	21.562780
22.5	6.4	9.1222	836.04	0.119463	99.880524	17.235443
22.5	6.5	9.1222	666.12	0.150344	99.849640	13.594854
22.5	6.6	9.1222	527.53	0.189203	99.810791	10.882461
22.5	6.7	9.1222	419.03	0.238076	99.761917	8.646691
22.5	6.8	9.1222	329.85	0.299535	99.700455	6.873089
22.5	6.9	9.1222	264.39	0.378603	99.621399	5.464442
22.5	7.0	9.1222	210.02	0.47903	99.52093	4.344400
22.5	7.1	9.1222	168.42	0.59472	99.404114	3.455438
22.5	7.2	9.1222	132.51	0.749002	99.250992	2.748990
22.5	7.3	9.1222	105.26	0.941111	99.058884	2.167639
22.5	7.4	9.1222	83.61	1.181907	98.818055	1.742100
22.5	7.5	9.1222	66.41	1.483391	98.516602	1.384036
22.5	7.6	9.1222	52.75	1.860331	98.139664	1.067791
22.5	7.7	9.1222	41.90	2.330784	97.669205	0.833392
22.5	7.8	9.1222	32.99	2.916644	97.083313	0.705438
22.5	7.9	9.1222	25.44	3.644354	96.355637	0.584993
22.5	8.0	9.1222	21.00	4.545042	95.454958	0.453017
22.5	8.1	9.1222	16.84	5.655354	94.344635	0.364079
22.5	8.2	9.1222	13.25	7.014911	92.983074	0.293434
22.5	8.3	9.1222	10.53	8.676120	91.323868	0.237314
22.5	8.4	9.1222	8.36	10.682600	89.317394	0.192743
22.5	8.5	9.1222	6.64	13.046604	86.933341	0.157336
22.5	8.6	9.1222	5.24	15.935094	84.064906	0.127212
22.5	8.7	9.1222	4.19	19.260144	80.739856	0.106471
22.5	8.8	9.1222	3.33	23.102173	76.897827	0.089126
22.5	8.9	9.1222	2.64	27.442337	72.557663	0.075030
22.5	9.0	9.1222	2.10	32.253675	67.746325	0.063833
22.5	9.1	9.1222	1.67	37.477613	62.522385	0.054439
22.5	9.2	9.1222	1.33	43.308626	56.691374	0.047875
22.5	9.3	9.1222	1.05	49.718624	50.281372	0.042263
22.5	9.4	9.1222	0.84	56.462875	43.537125	0.037806
22.5	9.5	9.1222	0.66	63.690790	36.309210	0.034265
22.5	9.6	9.1222	0.53	71.466184	28.535612	0.031452
22.5	9.7	9.1222	0.42	79.846646	20.153344	0.029218
22.5	9.8	9.1222	0.33	87.026413	12.973587	0.027444
22.5	9.9	9.1222	0.26	93.096604	6.903396	0.026034
22.5	10.0	9.1222	0.21	98.042993	1.957010	0.024914
22.5	10.1	9.1222	0.17	100.702408	0.297592	0.024025

** CONCENTRATIONS OF AMMONIA(NH4-NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 8.82 MG/L NH3-N

TEMP C	PH	PEA	RATIO	* UNIONIZED AMMONIA	* IONIZED AMMONIA	CONCENTRATION (mg/L NH3)
23.0	5.0	9.3067	20260.71	0.094939	99.995061	417.144721
23.0	5.1	9.3067	16043.64	0.086211	99.913774	331.344094
23.0	5.2	9.3067	12781.68	0.0807622	99.9192172	263.216572
23.0	5.3	9.3067	10155.46	0.0809647	99.9190143	209.100415
23.0	5.4	9.3067	8055.98	0.012346	99.987595	166.09167
23.0	5.5	9.3067	6407.05	0.015605	99.984390	131.941405
23.0	5.6	9.3067	5099.30	0.014845	99.985147	114.404240
23.0	5.7	9.3067	4042.54	0.024311	99.975686	83.257155
23.0	5.8	9.3067	3211.14	0.031132	99.968857	66.137945
23.0	5.9	9.3067	2550.76	0.039184	99.960800	52.519481
23.0	6.0	9.3067	2026.13	0.049332	99.950668	41.737451
23.0	6.1	9.3067	1609.39	0.062097	99.937897	33.157928
23.0	6.2	9.3067	1276.39	0.074162	99.921829	26.162545
23.0	6.3	9.3067	1015.46	0.084341	99.915611	20.928909
23.0	6.4	9.3067	806.61	0.123622	99.876175	16.624662
23.0	6.5	9.3067	640.71	0.155433	99.844162	13.212472
23.0	6.6	9.3067	508.94	0.161102	99.838444	10.496066
23.0	6.7	9.3067	404.26	0.246753	99.753235	8.344376
23.0	6.8	9.3067	321.12	0.310442	99.689545	6.632417
23.0	6.9	9.3067	255.07	0.340513	99.639482	5.272557
23.0	7.0	9.3067	202.61	0.491128	99.508465	4.192386
23.0	7.1	9.3067	150.94	0.617508	99.382492	3.334370
23.0	7.2	9.3067	127.44	0.776154	99.223446	2.652422
23.0	7.3	9.3067	101.55	0.975160	99.024826	2.111448
23.0	7.4	9.3067	80.66	1.224560	98.774316	1.641419
23.0	7.5	9.3067	64.07	1.536755	98.443242	1.339236
23.0	7.6	9.3067	50.89	1.924989	98.074494	1.064506
23.0	7.7	9.3067	40.43	2.413644	97.546105	0.852980
23.0	7.8	9.3067	32.11	3.020025	96.979465	0.681782
23.0	7.9	9.3067	25.51	3.772481	96.277509	0.545794
23.0	8.0	9.3067	20.26	4.703325	95.496641	0.437775
23.0	8.1	9.3067	16.09	5.849887	94.650101	0.351973
23.0	8.2	9.3067	12.78	7.254682	93.745316	0.283817
23.0	8.3	9.3067	10.15	8.964690	91.835244	0.229679
23.0	8.4	9.3067	8.07	11.025845	89.870154	0.186675
23.0	8.5	9.3067	6.41	13.500141	86.849417	0.147414
23.0	8.6	9.3067	5.09	16.421677	81.574323	0.125383
23.0	8.7	9.3067	4.04	19.810444	80.149556	0.113410
23.0	8.8	9.3067	3.21	23.745773	76.254227	0.096710
23.0	8.9	9.3067	2.55	28.162542	71.837418	0.073111
23.0	9.0	9.3067	2.03	33.044922	66.955078	0.062309
23.0	9.1	9.3067	1.61	38.322144	61.677856	0.053729
23.0	9.2	9.3067	1.28	43.849694	56.110306	0.046413
23.0	9.3	9.3067	1.02	49.615448	50.384522	0.041449
23.0	9.4	9.3067	0.81	55.351316	44.648642	0.037199
23.0	9.5	9.3067	0.64	60.948120	39.051880	0.033783
23.0	9.6	9.3067	0.51	66.270889	33.729111	0.031069
23.0	9.7	9.3067	0.40	71.210876	28.789124	0.028414
23.0	9.8	9.3067	0.32	75.692673	24.307327	0.027282
23.0	9.9	9.3067	0.26	79.675934	20.324664	0.025842
23.0	10.0	9.3067	0.20	83.151744	16.844251	0.024762
23.0	10.1	9.3067	0.16	86.136505	13.863495	0.023904

** CONCENTRATIONS OF AMMONIA (NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	pKa	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION ⁰⁰ NH4+MH3
23.5	5.0	9.2911	195.8-94	0.005115	99.994873	402.533203
23.5	5.1	9.2911	154.8-30	0.006439	99.993561	319.740047
23.5	5.2	9.2911	123.4-50	0.008107	99.991892	253.946085
23.5	5.3	9.2911	97.4-72	0.010235	99.989762	201.755707
23.5	5.4	9.2911	74.2-62	0.012667	99.987332	160.266679
23.5	5.5	9.2911	61.1-94	0.016173	99.983826	127.307129
23.5	5.6	9.2911	49.0-52	0.020360	99.979639	101.120090
23.5	5.7	9.2911	39.0-56	0.025031	99.974969	80.333176
23.5	5.8	9.2911	30.9-33	0.032265	99.967728	63.415231
23.5	5.9	9.2911	24.1-12	0.040610	99.959391	50.694557
23.5	6.0	9.2911	19.5-42	0.051127	99.948873	40.277400
23.5	6.1	9.2911	15.5-45	0.064352	99.935648	31.941790
23.5	6.2	9.2911	12.3-44	0.081009	99.918991	25.417847
23.5	6.3	9.2911	9.7-47	0.101954	99.898045	20.194366
23.5	6.4	9.2911	7.7-27	0.128325	99.871674	16.045212
23.5	6.5	9.2911	6.1-20	0.161497	99.838501	12.749427
23.5	6.6	9.2911	4.91-06	0.203220	99.796780	10.131466
23.5	6.7	9.2911	3.90-06	0.255714	99.742274	8.051355
23.5	6.8	9.2911	3.04-84	0.321712	99.678286	6.00134
23.5	6.9	9.2911	2.40-11	0.406673	99.593372	5.004057
23.5	7.0	9.2911	1.95-49	0.509919	99.491074	4.065827
23.5	7.1	9.2911	1.55-29	0.639067	99.360153	3.217954
23.5	7.2	9.2911	1.23-35	0.804187	99.195801	2.500350
23.5	7.3	9.2911	97.99	1.010309	98.989485	2.037497
23.5	7.4	9.2911	77.83	1.268590	98.731815	1.623074
23.5	7.5	9.2911	61.42	1.591817	98.408173	1.293490
23.5	7.6	9.2911	48.11	1.995750	98.004242	1.031692
23.5	7.7	9.2911	39.01	2.499581	97.500412	0.823734
23.5	7.8	9.2911	30.94	3.126546	96.873444	0.658554
23.5	7.9	9.2911	24.61	3.904475	96.095520	0.527344
23.5	8.0	9.2911	19.55	4.866261	95.133759	0.423119
23.5	8.1	9.2911	15.53	6.099997	93.949997	0.340331
23.5	8.2	9.2911	12.34	7.695009	92.500977	0.274570
23.5	8.3	9.2911	9.40	9.260873	90.739120	0.222333
23.5	8.4	9.2911	7.74	11.365717	88.634273	0.180841
23.5	8.5	9.2911	6.14	13.923245	86.076706	0.147862
23.5	8.6	9.2911	4.91	16.918427	83.081573	0.121702
23.5	8.7	9.2911	3.90	20.405135	79.594864	0.100406
23.5	8.8	9.2911	3.10	24.399399	75.600601	0.084387
23.5	8.9	9.2911	2.46	28.861724	71.138274	0.071266
23.5	9.0	9.2911	1.96	33.440912	66.559084	0.060844
23.5	9.1	9.2911	1.55	39.170894	60.829102	0.052565
23.5	9.2	9.2911	1.23	44.772247	55.227753	0.045968
23.5	9.3	9.2911	0.98	50.504476	49.495524	0.040765
23.5	9.4	9.2911	0.74	56.233337	43.766663	0.036615
23.5	9.5	9.2911	0.62	61.795914	38.204086	0.033319
23.5	9.6	9.2911	0.49	67.065598	32.934492	0.030701
23.5	9.7	9.2911	0.39	71.936416	28.063584	0.028422
23.5	9.8	9.2911	0.31	76.344620	23.655380	0.026970
23.5	9.9	9.2911	0.25	80.208711	19.791129	0.025658
23.5	10.0	9.2911	0.20	83.646635	16.353365	0.024615
23.5	10.1	9.2911	0.16	86.556690	13.443310	0.023787

⁰⁰ CONCENTRATIONS OF AMMONIA (NH4+MH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-M

TEMP C	PH	PNA	RATIO	A UNIONIZED AMMONIA	A IONIZED AMMONIA	CONCENTRATION NH ₄ ⁺ M3
24.0	5.0	9.2756	14864.42	0.005301	94.94450	344.43465
24.0	5.1	9.2756	14444.56	0.006673	94.94450	306.42734
24.0	5.2	9.2756	11982.88	0.004401	94.94450	245.06480
24.0	5.3	9.2756	9424.04	0.010576	94.94450	194.42154
24.0	5.4	9.2756	7510.13	0.013314	94.94450	154.85344
24.0	5.5	9.2756	5655.49	0.016760	94.94450	122.45003
24.0	5.6	9.2756	4244.57	0.021964	94.94450	97.44762
24.0	5.7	9.2756	3741.94	0.026541	94.94450	77.42046
24.0	5.8	9.2756	2444.44	0.033433	94.94450	61.44140
24.0	5.9	9.2756	2374.92	0.042044	94.94450	48.42015
24.0	6.0	9.2756	1866.47	0.052441	94.94450	38.44241
24.0	6.1	9.2756	1444.44	0.064444	94.94450	30.44444
24.0	6.2	9.2756	1144.44	0.083444	94.94450	24.44444
24.0	6.3	9.2756	944.44	0.105444	94.94450	19.44444
24.0	6.4	9.2756	751.42	0.132444	94.94450	15.44444
24.0	6.5	9.2756	565.44	0.157444	94.94450	12.44444
24.0	6.6	9.2756	424.44	0.215444	94.94450	9.44444
24.0	6.7	9.2756	374.40	0.264444	94.94450	7.44444
24.0	6.8	9.2756	244.44	0.333444	94.94450	5.44444
24.0	6.9	9.2756	237.50	0.412444	94.94450	4.44444
24.0	7.0	9.2756	186.45	0.527444	94.94450	3.44444
24.0	7.1	9.2756	144.45	0.662444	94.94450	2.44444
24.0	7.2	9.2756	119.43	0.833444	94.94450	1.44444
24.0	7.3	9.2756	94.45	1.044444	94.94450	0.94444
24.0	7.4	9.2756	75.10	1.314444	94.94450	0.64444
24.0	7.5	9.2756	56.44	1.644444	94.94450	0.44444
24.0	7.6	9.2756	42.34	2.044444	94.94450	0.34444
24.0	7.7	9.2756	37.64	2.544444	94.94450	0.24444
24.0	7.8	9.2756	24.40	3.244444	94.94450	0.14444
24.0	7.9	9.2756	23.75	4.044444	94.94450	0.09444
24.0	8.0	9.2756	18.47	5.044444	94.94450	0.06444
24.0	8.1	9.2756	14.49	6.244444	94.94450	0.04444
24.0	8.2	9.2756	11.40	7.504444	94.94450	0.03444
24.0	8.3	9.2756	9.46	8.844444	94.94450	0.02444
24.0	8.4	9.2756	7.51	10.244444	94.94450	0.01444
24.0	8.5	9.2756	5.47	11.644444	94.94450	0.00944
24.0	8.6	9.2756	4.74	13.044444	94.94450	0.00644
24.0	8.7	9.2756	3.76	14.444444	94.94450	0.00444
24.0	8.8	9.2756	2.99	15.844444	94.94450	0.00344
24.0	8.9	9.2756	2.34	17.244444	94.94450	0.00244
24.0	9.0	9.2756	1.89	18.644444	94.94450	0.00144
24.0	9.1	9.2756	1.50	20.044444	94.94450	0.00094
24.0	9.2	9.2756	1.14	21.444444	94.94450	0.00064
24.0	9.3	9.2756	0.95	22.844444	94.94450	0.00044
24.0	9.4	9.2756	0.75	24.244444	94.94450	0.00034
24.0	9.5	9.2756	0.60	25.644444	94.94450	0.00024
24.0	9.6	9.2756	0.47	27.044444	94.94450	0.00014
24.0	9.7	9.2756	0.34	28.444444	94.94450	0.00009
24.0	9.8	9.2756	0.24	29.844444	94.94450	0.00006
24.0	9.9	9.2756	0.19	31.244444	94.94450	0.00004
24.0	10.0	9.2756	0.15	32.644444	94.94450	0.00003
24.0	10.1	9.2756	0.15	34.044444	94.94450	0.00002

CONCENTRATIONS OF AMMONIA (NH₄⁺ M3) WHICH CONTAIN AN UNIONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	PH	PRA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION mg/L NH3
20.5	5.0	9.2602	14206.05	9.095442	91.904558	374.481301
20.5	5.1	9.2602	14661.60	9.060914	90.939086	297.784008
20.5	5.2	9.2602	11887.27	9.008703	90.991297	236.543544
20.5	5.3	9.2602	9174.67	8.910958	90.989042	187.497583
20.5	5.4	9.2602	7248.00	8.813733	90.986167	140.256790
20.5	5.5	9.2602	5751.30	8.713632	90.942620	118.563263
20.5	5.6	9.2602	4573.19	8.621862	90.978136	94.182526
20.5	5.7	9.2602	3632.62	8.527521	90.972473	74.416204
20.5	5.8	9.2602	2855.50	8.436644	90.965347	59.432934
20.5	5.9	9.2602	2292.03	8.346310	90.956390	47.213562
20.5	6.0	9.2602	1823.63	8.256493	90.945049	37.507355
20.5	6.1	9.2602	1446.14	8.166103	90.930893	29.797455
20.5	6.2	9.2602	1148.74	8.076473	90.913025	23.673187
20.5	6.3	9.2602	912.44	8.004471	90.890518	18.404533
20.5	6.4	9.2602	724.81	8.137777	90.862213	14.944422
20.5	6.5	9.2602	575.74	8.173384	90.826599	11.475021
20.5	6.6	9.2602	457.33	8.219145	90.781415	9.416911
20.5	6.7	9.2602	363.27	8.274524	90.724444	7.500255
20.5	6.8	9.2602	285.55	8.343514	90.656633	5.941405
20.5	6.9	9.2602	229.21	8.434492	90.565598	4.733453
20.5	7.0	9.2602	182.07	8.546253	90.453735	3.749316
20.5	7.1	9.2602	144.62	8.646714	90.313274	2.904313
20.5	7.2	9.2602	114.68	8.742993	90.136993	2.345882
20.5	7.3	9.2602	91.25	1.044020	90.915970	1.894411
20.5	7.4	9.2602	72.48	1.360874	90.639114	1.512993
20.5	7.5	9.2602	57.57	1.707223	90.292770	1.208050
20.5	7.6	9.2602	45.73	2.138604	90.860184	0.962236
20.5	7.7	9.2602	36.33	2.679011	90.320944	0.748567
20.5	7.8	9.2602	28.84	3.344417	90.650554	0.614730
20.5	7.9	9.2602	22.92	4.183434	90.819465	0.492533
20.5	8.0	9.2602	18.21	5.204497	90.793603	0.395467
20.5	8.1	9.2602	14.46	6.467390	90.532608	0.318366
20.5	8.2	9.2602	11.49	8.007855	91.992142	0.257123
20.5	8.3	9.2602	9.13	9.875449	90.123505	0.208475
20.5	8.4	9.2602	7.25	12.12717	87.876282	0.169432
20.5	8.5	9.2602	5.76	14.746247	84.201691	0.139136
20.5	8.6	9.2602	4.57	17.942624	82.057571	0.114756
20.5	8.7	9.2602	3.63	21.545371	78.414627	0.095389
20.5	8.8	9.2602	2.89	25.735961	74.264038	0.080085
20.5	8.9	9.2602	2.29	30.375473	69.624527	0.067785
20.5	9.0	9.2602	1.82	35.521331	64.474667	0.058078
20.5	9.1	9.2602	1.45	40.879054	59.120941	0.050368
20.5	9.2	9.2602	1.15	45.517740	53.442204	0.044244
20.5	9.3	9.2602	0.91	52.478944	47.521204	0.039374
20.5	9.4	9.2602	0.72	57.974410	42.023590	0.035514
20.5	9.5	9.2602	0.58	63.441305	36.558695	0.032445
20.5	9.6	9.2602	0.46	69.617966	31.382034	0.030007
20.5	9.7	9.2602	0.36	73.352432	26.647568	0.028070
20.5	9.8	9.2602	0.29	77.605713	22.394287	0.026532
20.5	9.9	9.2602	0.23	81.352642	18.647368	0.025310
20.5	10.0	9.2602	0.18	84.597184	15.402832	0.024339
20.5	10.1	9.2602	0.14	87.344791	12.655209	0.023568

CONCENTRATIONS OF AMMONIA (NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	PXA	RATIO	% IONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+ MG/L
25.0	5.0	9.2448	1752.74	0.015690	99.984308	361.484238
25.0	5.1	9.2448	1135.57	0.017146	98.982854	287.427490
25.0	5.2	9.2448	1104.70	0.019018	98.980982	278.318391
25.0	5.3	9.2448	8807.24	0.013533	98.986467	181.362625
25.0	5.4	9.2448	6952.89	0.014292	98.985703	144.065857
25.0	5.5	9.2448	5557.04	0.017442	98.982558	116.439957
25.0	5.6	9.2448	4414.12	0.022644	97.977351	90.407333
25.0	5.7	9.2448	3206.27	0.028512	97.971481	72.214584
25.0	5.8	9.2448	2785.13	0.035512	96.964496	57.466604
25.0	5.9	9.2448	2216.31	0.045181	95.954819	45.572052
25.0	6.0	9.2448	1757.30	0.058873	94.941115	36.203415
25.0	6.1	9.2448	1395.88	0.077544	92.924606	26.741644
25.0	6.2	9.2448	1108.79	0.101107	89.898882	22.450494
25.0	6.3	9.2448	898.74	0.13412	86.865841	18.155045
25.0	6.4	9.2448	694.60	0.17735	82.82254	14.253119
25.0	6.5	9.2448	555.71	0.23425	76.567374	11.62494
25.0	6.6	9.2448	441.42	0.28030	71.97956	9.109189
25.0	6.7	9.2448	350.63	0.34344	65.64227	7.240087
25.0	6.8	9.2448	275.52	0.43763	56.250014	5.755246
25.0	6.9	9.2448	221.23	0.56970	43.03174	3.638424
25.0	7.0	9.2448	175.71	0.74627	24.94696	2.494738
25.0	7.1	9.2448	139.54	0.97120	2.10186	2.10186
25.0	7.2	9.2448	110.54	1.22645	0.877350	1.84660
25.0	7.3	9.2448	88.04	1.49424	0.50754	1.441082
25.0	7.4	9.2448	69.46	1.76641	0.232330	1.14416
25.0	7.5	9.2448	55.57	2.15213	0.768775	0.929882
25.0	7.6	9.2448	44.14	2.77440	0.727112	0.742549
25.0	7.7	9.2448	35.04	3.46590	0.534027	0.594063
25.0	7.8	9.2448	27.85	4.34570	0.675430	0.674117
25.0	7.9	9.2448	22.12	5.344014	0.615942	0.742428
25.0	8.0	9.2448	17.57	6.64472	0.315125	0.314804
25.0	8.1	9.2448	13.96	8.27255	0.727432	0.244495
25.0	8.2	9.2448	11.09	10.145113	0.803679	0.201940
25.0	8.3	9.2448	8.41	12.265875	0.64019	0.16441
25.0	8.4	9.2448	7.04	14.753261	0.74724	0.135014
25.0	8.5	9.2448	5.86	17.484504	0.150346	0.111480
25.0	8.6	9.2448	4.81	20.14013	0.63387	0.092787
25.0	8.7	9.2448	3.79	22.61481	0.51419	0.077438
25.0	8.8	9.2448	2.79	25.12364	0.870636	0.064143
25.0	8.9	9.2448	2.21	27.63373	0.3733627	0.054774
25.0	9.0	9.2448	1.76	30.14617	0.262614	0.049132
25.0	9.1	9.2448	1.40	32.61492	0.250343	0.043421
25.0	9.2	9.2448	1.11	35.14442	0.403055	0.03725
25.0	9.3	9.2448	0.88	37.61441	0.133544	0.034995
25.0	9.4	9.2448	0.70	40.14441	0.721644	0.032833
25.0	9.5	9.2448	0.56	42.61351	0.624741	0.029679
25.0	9.6	9.2448	0.44	45.14441	0.261304	0.027410
25.0	9.7	9.2448	0.35	47.61441	0.178500	0.024325
25.0	9.8	9.2448	0.28	50.14441	0.116211	0.021465
25.0	9.9	9.2448	0.22	52.61441	0.07144	0.018208
25.0	10.0	9.2448	0.18	55.14441	0.047144	0.014208
25.0	10.1	9.2448	0.14	57.61441	0.024942	0.009344

CONCENTRATIONS OF AMMONIA (NH4+ NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	pH	pKa	RATIO	A UNIONIZED AMMONIA	% UNIONIZED AMMONIA	CONCENTRATION NH4-NH3
25.5	5.0	9.2295	16461.52	0.00493	94.994095	349.274116
25.5	5.1	9.2295	13474.62	0.007421	94.942569	277.624911
25.5	5.2	9.2295	10703.29	0.009367	94.900646	220.601184
25.5	5.3	9.2295	8501.91	0.011761	93.994235	175.075424
25.5	5.4	9.2295	6753.74	0.014403	94.945184	139.071747
25.5	5.5	9.2295	5364.37	0.017433	94.941154	110.473053
25.5	5.6	9.2295	4261.04	0.021443	94.976532	87.756180
25.5	5.7	9.2295	3384.70	0.026936	94.970459	69.711578
25.5	5.8	9.2295	2668.56	0.033718	94.962614	55.778128
25.5	5.9	9.2295	2135.61	0.042001	94.953196	43.992722
25.5	6.0	9.2295	1696.37	0.051913	94.941046	36.948444
25.5	6.1	9.2295	1347.44	0.063421	94.925842	27.745213
25.5	6.2	9.2295	1070.33	0.076754	94.906647	22.658945
25.5	6.3	9.2295	850.19	0.091744	94.882507	17.524305
25.5	6.4	9.2295	675.34	0.108660	94.852142	13.925403
25.5	6.5	9.2295	536.44	0.127454	94.813494	11.011949
25.5	6.6	9.2295	426.11	0.147454	94.765854	8.744266
25.5	6.7	9.2295	338.47	0.169425	94.705414	6.949777
25.5	6.8	9.2295	266.85	0.193436	94.624425	5.564414
25.5	6.9	9.2295	213.56	0.219457	94.533436	4.417464
25.5	7.0	9.2295	169.04	0.247457	94.433471	3.513474
25.5	7.1	9.2295	134.75	0.276444	94.333471	2.755090
25.5	7.2	9.2295	107.04	0.306414	94.233471	2.224457
25.5	7.3	9.2295	85.02	0.337454	94.133471	1.771186
25.5	7.4	9.2295	67.54	0.369454	94.033471	1.411134
25.5	7.5	9.2295	53.65	0.402454	94.033471	1.125144
25.5	7.6	9.2295	42.61	0.436454	94.033471	0.837970
25.5	7.7	9.2295	33.45	0.471454	94.033471	0.614181
25.5	7.8	9.2295	26.89	0.506414	94.033471	0.460323
25.5	7.9	9.2295	21.36	0.541454	94.033471	0.349483
25.5	8.0	9.2295	16.96	0.576414	94.033471	0.264044
25.5	8.1	9.2295	13.48	0.611454	94.033471	0.204080
25.5	8.2	9.2295	10.70	0.646414	94.033471	0.154052
25.5	8.3	9.2295	8.50	0.681454	94.033471	0.114047
25.5	8.4	9.2295	6.75	0.716414	94.033471	0.084024
25.5	8.5	9.2295	5.36	0.751454	94.033471	0.064015
25.5	8.6	9.2295	4.26	0.786414	94.033471	0.049024
25.5	8.7	9.2295	3.34	0.821454	94.033471	0.039024
25.5	8.8	9.2295	2.69	0.856414	94.033471	0.034024
25.5	8.9	9.2295	2.14	0.891454	94.033471	0.034024
25.5	9.0	9.2295	1.70	0.926414	94.033471	0.034024
25.5	9.1	9.2295	1.35	0.961454	94.033471	0.034024
25.5	9.2	9.2295	1.07	0.996414	94.033471	0.034024
25.5	9.3	9.2295	0.85	1.031454	94.033471	0.034024
25.5	9.4	9.2295	0.64	1.066414	94.033471	0.034024
25.5	9.5	9.2295	0.54	1.101454	94.033471	0.034024
25.5	9.6	9.2295	0.43	1.136414	94.033471	0.034024
25.5	9.7	9.2295	0.34	1.171454	94.033471	0.034024
25.5	9.8	9.2295	0.27	1.206414	94.033471	0.034024
25.5	9.9	9.2295	0.21	1.241454	94.033471	0.034024
25.5	10.0	9.2295	0.17	1.276414	94.033471	0.034024
25.5	10.1	9.2295	0.13	1.311454	94.033471	0.034024

.. CONCENTRATIONS OF AMMONIA (NH4-NH3) WHICH CONTAIN AN UNIONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	PRA	RATIO	A UNIONIZED AMMONIA	* IONIZED AMMONIA	CONCENTRATION NH4+NH3 **
26.0	5.0	9.2142	16377.31	0.006100	99.993891	337.229492
26.0	5.1	9.2142	13004.94	0.007049	99.992951	267.475488
26.0	5.2	9.2142	10333.42	0.009479	99.990521	212.745721
26.0	5.3	9.2142	8706.14	0.012142	99.987858	169.026077
26.0	5.4	9.2142	6519.96	0.015335	99.984665	134.266663
26.0	5.5	9.2142	5179.00	0.019305	99.980682	106.456154
26.0	5.6	9.2142	4113.43	0.024302	99.975693	84.724394
26.0	5.7	9.2142	3247.74	0.030544	99.969406	67.303299
26.0	5.8	9.2142	2595.66	0.038311	99.961447	53.465164
26.0	5.9	9.2142	2061.81	0.048473	99.951523	42.473140
26.0	6.0	9.2142	1637.75	0.061022	99.939965	33.741943
26.0	6.1	9.2142	1300.92	0.076810	99.923147	26.406454
26.0	6.2	9.2142	1033.36	0.096678	99.903320	21.247379
26.0	6.3	9.2142	820.82	0.121641	99.879311	16.921371
26.0	6.4	9.2142	652.01	0.153134	99.846463	13.445163
26.0	6.5	9.2142	517.91	0.192713	99.803281	10.444299
26.0	6.6	9.2142	411.39	0.242900	99.757507	8.491087
26.0	6.7	9.2142	326.74	0.305044	99.694916	6.748950
26.0	6.8	9.2142	259.57	0.383775	99.616211	5.365122
26.0	6.9	9.2142	206.14	0.482664	99.517334	4.265909
26.0	7.0	9.2142	163.74	0.606878	99.393112	3.392172
26.0	7.1	9.2142	130.09	0.762415	99.237183	2.699713
26.0	7.2	9.2142	103.34	0.958433	99.041565	2.132499
26.0	7.3	9.2142	82.04	1.203609	99.746347	1.710592
26.0	7.4	9.2142	65.20	1.510441	99.489456	1.343044
26.0	7.5	9.2142	51.79	1.844248	99.105743	1.066974
26.0	7.6	9.2142	41.14	2.373075	97.626923	0.867651
26.0	7.7	9.2142	32.68	2.969275	97.030716	0.693435
26.0	7.8	9.2142	25.96	3.709571	96.240421	0.550550
26.0	7.9	9.2142	20.62	4.625634	95.374359	0.445127
26.0	8.0	9.2142	16.34	5.734405	94.445590	0.357413
26.0	8.1	9.2142	13.01	7.134002	92.861944	0.284456
26.0	8.2	9.2142	10.33	9.023131	91.176865	0.233164
26.0	8.3	9.2142	8.21	10.959559	89.140442	0.194402
26.0	8.4	9.2142	6.52	13.247464	86.702530	0.154441
26.0	8.5	9.2142	5.14	16.143244	83.416711	0.117230
26.0	8.6	9.2142	4.11	19.554144	80.445831	0.085247
26.0	8.7	9.2142	3.27	23.430474	76.561222	0.067475
26.0	8.8	9.2142	2.60	27.810471	72.189529	0.074037
26.0	8.9	9.2142	2.04	32.659215	67.340485	0.063044
26.0	9.0	9.2142	1.64	37.910049	62.049951	0.054313
26.0	9.1	9.2142	1.30	43.459433	56.540070	0.047377
26.0	9.2	9.2142	1.03	49.178741	50.821259	0.041468
26.0	9.3	9.2142	0.82	54.919154	45.080441	0.037491
26.0	9.4	9.2142	0.65	60.531504	38.468491	0.034015
26.0	9.5	9.2142	0.52	65.873257	34.120743	0.031254
26.0	9.6	9.2142	0.41	70.851344	29.144651	0.029061
26.0	9.7	9.2142	0.33	75.349760	24.630234	0.027319
26.0	9.8	9.2142	0.26	79.391556	20.604444	0.025935
26.0	9.9	9.2142	0.21	82.905533	17.094467	0.024435
26.0	10.0	9.2142	0.16	85.926593	14.073410	0.023462
26.0	10.1	9.2142	0.13	88.447669	11.512131	0.023269

** CONCENTRATIONS OF AMMONIA (NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	PFA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4-NH3 **
26.5	5.0	9.1990	15813.26	0.004323	99.995676	325.615474
26.5	5.1	9.1990	12590.93	0.007961	99.992038	258.450146
26.5	5.2	9.1990	7977.52	0.010022	99.989978	205.447467
26.5	5.3	9.1990	7425.44	0.012516	98.987341	163.205134
26.5	5.4	9.1990	6255.40	0.015842	98.984116	129.642444
26.5	5.5	9.1990	5000.62	0.019944	98.974956	102.943276
26.5	5.6	9.1990	3972.14	0.025169	98.974823	81.066992
26.5	5.7	9.1990	3155.19	0.031644	98.968307	64.445911
26.5	5.8	9.1990	2506.26	0.038444	98.960114	51.624466
26.5	5.9	9.1990	1990.80	0.050205	98.949733	41.011063
26.5	6.0	9.1990	1581.35	0.063147	98.936794	32.540551
26.5	6.1	9.1990	1259.11	0.079547	98.920441	25.843411
26.5	6.2	9.1990	997.76	0.100124	98.899472	20.564460
26.5	6.3	9.1990	797.75	0.126012	98.873474	16.134264
26.5	6.4	9.1990	625.55	0.154542	98.841400	12.983000
26.5	6.5	9.1990	500.07	0.189573	98.810415	10.317004
26.5	6.6	9.1990	397.22	0.231114	98.768871	8.199340
26.5	6.7	9.1990	315.52	0.279433	98.720567	6.517207
26.5	6.8	9.1990	250.53	0.337410	98.662545	5.141049
26.5	6.9	9.1990	199.04	0.404744	98.596144	4.114694
26.5	7.0	9.1990	158.14	0.482340	98.521547	3.276424
26.5	7.1	9.1990	125.61	0.569410	98.430100	2.606956
26.5	7.2	9.1990	99.78	0.662281	98.337391	2.075016
26.5	7.3	9.1990	79.76	0.766002	98.233941	1.552460
26.5	7.4	9.1990	62.56	0.873541	98.126417	1.134449
26.5	7.5	9.1990	50.01	0.990491	98.013905	0.850244
26.5	7.6	9.1990	39.72	0.455644	97.544342	0.678476
26.5	7.7	9.1990	31.55	0.071435	96.929055	0.670261
26.5	7.8	9.1990	25.06	0.836813	96.163177	0.536643
26.5	7.9	9.1990	19.91	0.782745	95.217255	0.430506
26.5	8.0	9.1990	15.81	0.947464	94.052536	0.344194
26.5	8.1	9.1990	12.56	0.373446	92.626144	0.279230
26.5	8.2	9.1990	9.94	0.103190	90.890804	0.226035
26.5	8.3	9.1990	7.93	0.203524	84.796483	0.193781
26.5	8.4	9.1990	6.30	0.706773	86.293213	0.150214
26.5	8.5	9.1990	5.00	0.664352	83.335444	0.123557
26.5	8.6	9.1990	3.97	0.111344	79.898611	0.102340
26.5	8.7	9.1990	3.16	0.055336	75.944444	0.085554
26.5	8.8	9.1990	2.51	0.514577	71.470423	0.072196
26.5	8.9	9.1990	1.99	0.434444	66.565002	0.051582
26.5	9.0	9.1990	1.58	0.744444	61.261520	0.033151
26.5	9.1	9.1990	1.26	0.323044	55.676956	0.046454
26.5	9.2	9.1990	1.00	0.054915	49.945084	0.041135
26.5	9.3	9.1990	0.79	0.785304	44.214491	0.034909
26.5	9.4	9.1990	0.63	0.136592	38.614344	0.033553
26.5	9.5	9.1990	0.50	0.642674	31.337326	0.030847
26.5	9.6	9.1990	0.40	0.566870	24.430130	0.024769
26.5	9.7	9.1990	0.32	0.761466	23.965136	0.027087
26.5	9.8	9.1990	0.25	0.954122	20.040878	0.025751
26.5	9.9	9.1990	0.20	0.306561	14.643439	0.024689
26.5	10.0	9.1990	0.16	0.465109	13.654892	0.023846
26.5	10.1	9.1990	0.13	0.666873	11.159427	0.023176

** CONCENTRATIONS OF AMMONIA (NH4-NH3) WHICH CONTAIN AN UNIONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-M

TEMP C	PH	PKA	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+M3	CONCENTRATION NH3-M
27.0	5.0	9.1419	15270.14	0.00554	99.99446	31.443774	
27.0	5.1	9.1419	12129.72	0.00524	99.99476	240.77154	
27.0	5.2	9.1419	9634.99	0.010374	98.98963	198.405075	
27.0	5.3	9.1419	7653.34	0.011054	98.98895	157.401165	
27.0	5.4	9.1419	6074.29	0.016447	98.983551	125.143024	
27.0	5.5	9.1419	4878.94	0.020704	97.979296	99.444907	
27.0	5.6	9.1419	3835.74	0.026064	97.973936	78.943344	
27.0	5.7	9.1419	3040.87	0.032614	96.967386	62.755722	
27.0	5.8	9.1419	2420.22	0.041301	95.958694	49.452905	
27.0	5.9	9.1419	1927.45	0.051990	94.948010	39.403451	
27.0	6.0	9.1419	1527.06	0.065442	93.934558	31.443774	
27.0	6.1	9.1419	1212.97	0.082133	91.917867	24.077151	
27.0	6.2	9.1419	963.49	0.103634	89.896366	19.840508	
27.0	6.3	9.1419	765.33	0.130449	86.955552	15.740117	
27.0	6.4	9.1419	607.43	0.16221	83.83779	12.514167	
27.0	6.5	9.1419	487.89	0.20024	79.79975	9.943549	
27.0	6.6	9.1419	383.57	0.24524	75.45476	7.918500	
27.0	6.7	9.1419	304.09	0.30127	69.84616	6.244185	
27.0	6.8	9.1419	242.03	0.37143	62.82549	5.003491	
27.0	6.9	9.1419	192.75	0.45743	54.25411	3.97972	
27.0	7.0	9.1419	152.71	0.560544	43.94411	3.14449	
27.0	7.1	9.1419	121.30	0.681765	31.82343	2.514167	
27.0	7.2	9.1419	96.35	0.827154	17.2794	2.004469	
27.0	7.3	9.1419	76.54	0.984724	1.526459	1.594459	
27.0	7.4	9.1419	60.74	1.161253	1.341724	1.272349	
27.0	7.5	9.1419	48.79	1.377673	0.771222	1.014494	
27.0	7.6	9.1419	38.36	1.640725	0.459274	0.67654	
27.0	7.7	9.1419	30.47	2.028773	0.482327	0.516927	
27.0	7.8	9.1419	24.20	2.564343	0.432146	0.41434	
27.0	7.9	9.1419	19.27	3.367802	0.505534	0.335020	
27.0	8.0	9.1419	15.27	4.645844	0.34372	0.270351	
27.0	8.1	9.1419	12.13	6.414013	0.214023	0.214023	
27.0	8.2	9.1419	9.64	9.462573	0.547427	0.174179	
27.0	8.3	9.1419	7.65	11.55742	0.444149	0.145768	
27.0	8.4	9.1419	6.04	14.15226	0.874771	0.12022	
27.0	8.5	9.1419	4.83	17.15151	0.844444	0.094572	
27.0	8.6	9.1419	3.84	20.674513	74.32147	0.073128	
27.0	8.7	9.1419	3.05	24.76471	75.240329	0.073424	
27.0	8.8	9.1419	2.42	29.237013	70.762485	0.040175	
27.0	8.9	9.1419	1.92	34.216904	65.783086	0.052033	
27.0	9.0	9.1419	1.53	39.570674	60.429321	0.05544	
27.0	9.1	9.1419	1.21	45.14471	54.853263	0.044430	
27.0	9.2	9.1419	0.94	50.724110	49.27589	0.036349	
27.0	9.3	9.1419	0.77	56.45111	43.54889	0.031108	
27.0	9.4	9.1419	0.61	62.140536	37.84944	0.030533	
27.0	9.5	9.1419	0.44	67.43444	32.56552	0.028484	
27.0	9.6	9.1419	0.34	72.275244	27.72701	0.026864	
27.0	9.7	9.1419	0.26	76.45752	23.54244	0.025573	
27.0	9.8	9.1419	0.24	80.13031	19.86969	0.024549	
27.0	9.9	9.1419	0.19	83.474603	16.525397	0.023734	
27.0	10.0	9.1419	0.15	86.751401	13.248199	0.023088	
27.0	10.1	9.1419	0.12	89.141763	10.858237		

CONCENTRATIONS OF AMMONIA (NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	pKa	RATIO	UNIONIZED AMMONIA	10 ⁻¹² ED AMMONIA	CONCENTRATION NH ₄ ⁺ NM3
27.5	5.0	9.1687	14747.86	0.006740	99.993110	303.674055
27.5	5.1	9.1687	11714.66	9.008539	99.991455	241.225143
27.5	5.2	9.1687	9305.29	0.010752	99.989248	191.619440
27.5	5.3	9.1687	7381.44	0.013521	99.986455	152.210400
27.5	5.4	9.1687	5871.26	0.017024	99.982471	120.404775
27.5	5.5	9.1687	4661.71	0.021334	99.978561	96.666387
27.5	5.6	9.1687	3704.32	0.026347	99.973037	76.246722
27.5	5.7	9.1687	2942.41	0.032742	99.966014	60.604963
27.5	5.8	9.1687	2337.40	0.040764	99.957230	48.147720
27.5	5.9	9.1687	1850.67	0.050331	99.946167	38.249374
27.5	6.0	9.1687	1474.60	0.062289	99.932234	30.344410
27.5	6.1	9.1687	1171.44	0.077000	99.914703	24.141373
27.5	6.2	9.1687	930.54	0.094524	99.894639	19.140435
27.5	6.3	9.1687	738.14	0.115137	99.872971	15.239422
27.5	6.4	9.1687	587.13	0.139024	99.849026	12.109473
27.5	6.5	9.1687	466.18	0.166219	99.823074	9.623104
27.5	6.6	9.1687	370.44	0.205219	99.793789	7.644307
27.5	6.7	9.1687	294.27	0.255474	99.761316	6.044514
27.5	6.8	9.1687	233.74	0.31701	99.726424	4.833365
27.5	6.9	9.1687	185.67	0.391340	99.689508	3.952755
27.5	7.0	9.1687	147.44	0.47840	99.650174	3.262702
27.5	7.1	9.1687	117.15	0.57902	99.608794	2.736603
27.5	7.2	9.1687	93.06	0.69415	99.565174	2.32534
27.5	7.3	9.1687	73.92	0.82444	99.519340	1.979515
27.5	7.4	9.1687	58.71	0.97041	99.471613	1.643372
27.5	7.5	9.1687	46.64	1.13415	99.422425	1.312474
27.5	7.6	9.1687	37.05	1.32656	99.372364	1.002484
27.5	7.7	9.1687	29.43	1.54060	99.321405	0.791405
27.5	7.8	9.1687	23.37	1.78424	99.269600	0.612786
27.5	7.9	9.1687	18.57	2.05863	99.216437	0.461444
27.5	8.0	9.1687	14.72	2.36334	99.162124	0.334330
27.5	8.1	9.1687	11.73	2.70063	99.107453	0.236609
27.5	8.2	9.1687	9.31	3.07263	99.052471	0.161111
27.5	8.3	9.1687	7.39	3.48067	99.000000	0.101111
27.5	8.4	9.1687	5.87	3.92547	98.950117	0.064719
27.5	8.5	9.1687	4.66	4.40621	98.902445	0.045424
27.5	8.6	9.1687	3.70	4.92455	98.856931	0.033581
27.5	8.7	9.1687	2.94	5.48219	98.813471	0.025112
27.5	8.8	9.1687	2.34	6.08063	98.771951	0.019751
27.5	8.9	9.1687	1.86	6.72047	98.732203	0.016480
27.5	9.0	9.1687	1.47	7.40219	98.694278	0.01393
27.5	9.1	9.1687	1.17	8.12614	98.658014	0.011818
27.5	9.2	9.1687	0.93	8.89382	98.623440	0.009649
27.5	9.3	9.1687	0.74	9.70750	98.590418	0.007643
27.5	9.4	9.1687	0.59	10.5682	98.558835	0.005943
27.5	9.5	9.1687	0.47	11.4761	98.528647	0.004643
27.5	9.6	9.1687	0.37	12.4302	98.499807	0.003627
27.5	9.7	9.1687	0.29	13.4302	98.472353	0.002802
27.5	9.8	9.1687	0.23	14.4761	98.446247	0.002143
27.5	9.9	9.1687	0.19	15.5682	98.421453	0.001647
27.5	10.0	9.1687	0.15	16.7075	98.397953	0.001247
27.5	10.1	9.1687	0.12	17.8938	98.375753	0.000947

CONCENTRATIONS OF AMMONIA (NH₄⁺ NM3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	PH	pKa	RATIO	UNIONIZED AMMONIA	IONIZED AMMONIA	CONCENTRATION NH ₄ ⁺ /NH ₃
24.0	5.0	9.1537	14244.64	0.007029	94.992941	293.322510
24.0	5.1	9.1537	11315.12	0.008837	94.991150	232.344039
24.0	5.2	9.1537	8977.94	0.011129	94.989461	185.342245
25.0	5.3	9.1537	7139.34	0.014005	94.985992	147.020432
24.0	5.4	9.1537	5671.02	0.017439	94.982351	116.744957
24.0	5.5	9.1537	4504.66	0.021949	94.977794	92.771545
24.0	5.6	9.1537	3576.18	0.027434	94.972361	73.535113
24.0	5.7	9.1537	2842.25	0.035171	94.966824	58.542587
24.0	5.8	9.1537	2257.69	0.046274	94.959579	46.506332
24.0	5.9	9.1537	1791.35	0.061050	94.949260	36.345572
24.0	6.0	9.1537	1424.71	0.080299	94.936167	28.351195
24.0	6.1	9.1537	1131.51	0.111132	94.920455	23.318741
24.0	6.2	9.1537	897.79	0.146879	94.898123	18.527004
24.0	6.3	9.1537	713.93	0.187602	94.868123	14.726765
24.0	6.4	9.1537	567.10	0.234434	94.823975	11.697370
24.0	6.5	9.1537	450.47	0.287864	94.772129	9.245797
24.0	6.6	9.1537	357.62	0.350593	94.718475	7.344163
24.0	6.7	9.1537	284.23	0.426042	94.655921	5.872259
24.0	6.8	9.1537	225.77	0.51517	94.584540	4.649229
24.0	6.9	9.1537	179.34	0.617099	94.502902	3.713150
24.0	7.0	9.1537	142.45	0.740007	94.412393	2.953691
24.0	7.1	9.1537	113.15	0.883294	94.314654	2.350434
24.0	7.2	9.1537	89.79	1.04295	94.210694	1.871257
24.0	7.3	9.1537	71.39	1.32750	94.102622	1.490624
24.0	7.4	9.1537	56.71	1.646334	94.08203	1.184244
24.0	7.5	9.1537	45.05	2.011713	94.048241	0.948124
24.0	7.6	9.1537	35.78	2.425509	94.001326	0.757357
24.0	7.7	9.1537	28.42	2.898891	94.040134	0.605425
24.0	7.8	9.1537	22.58	3.424334	94.075452	0.485460
24.0	7.9	9.1537	17.93	4.01515	94.118475	0.394450
24.0	8.0	9.1537	14.25	4.654375	94.164674	0.313304
24.0	8.1	9.1537	11.32	5.34794	94.214203	0.253478
24.0	8.2	9.1537	8.99	6.091713	94.268241	0.205659
24.0	8.3	9.1537	7.14	6.885509	94.327476	0.167596
24.0	8.4	9.1537	5.67	7.724491	94.391030	0.137361
24.0	8.5	9.1537	4.59	8.695417	94.458143	0.111345
24.0	8.6	9.1537	3.84	9.746244	94.529474	0.084268
24.0	8.7	9.1537	3.24	10.86244	94.604411	0.067414
24.0	8.8	9.1537	2.84	12.045555	94.682441	0.057717
24.0	8.9	9.1537	2.54	13.284491	94.762441	0.050922
24.0	9.0	9.1537	2.34	14.574476	94.844476	0.046349
24.0	9.1	9.1537	2.24	15.913669	94.928434	0.043489
24.0	9.2	9.1537	2.14	17.296351	95.014434	0.041097
24.0	9.3	9.1537	2.04	18.72442	95.102442	0.039291
24.0	9.4	9.1537	1.94	20.19791	95.192441	0.037947
24.0	9.5	9.1537	1.84	21.712215	95.284241	0.036966
24.0	9.6	9.1537	1.74	23.266509	95.378434	0.036294
24.0	9.7	9.1537	1.64	24.860709	95.474434	0.035839
24.0	9.8	9.1537	1.54	26.494473	95.571434	0.035479
24.0	9.9	9.1537	1.44	28.167277	95.669434	0.035191
24.0	10.0	9.1537	1.34	29.879464	95.768434	0.034967
24.0	10.1	9.1537	1.24	31.631466	95.868434	0.034792

CONCENTRATIONS OF AMMONIA (NH₄⁺/NH₃) WHICH CONTAIN AN UNIONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	PH	pKa	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ -NH ₃ **
28.5	5.0	9.1386	13760.60	0.007267	99.992732	283.351318
28.5	5.1	9.1386	16910.65	0.019144	98.980855	225.074583
28.5	5.2	9.1386	8682.34	0.011516	98.988484	178.748756
28.5	5.3	9.1386	6886.67	0.014606	98.985393	142.022468
28.5	5.4	9.1386	5470.23	0.017251	98.982748	112.17276
28.5	5.5	9.1386	4351.52	0.022975	97.977024	89.618301
28.5	5.6	9.1386	3456.51	0.028922	97.971078	71.190613
28.5	5.7	9.1386	2755.63	0.036404	96.963595	56.553740
28.5	5.8	9.1386	2189.93	0.045631	95.434368	44.925990
28.5	5.9	9.1386	1722.34	0.057691	94.232308	35.690247
28.5	6.0	9.1386	1376.08	0.072617	92.738382	28.354065
28.5	6.1	9.1386	1093.06	0.091403	90.858595	22.526608
28.5	6.2	9.1386	868.25	0.115042	88.495457	17.497842
28.5	6.3	9.1386	688.64	0.147706	85.229299	14.271025
28.5	6.4	9.1386	547.63	0.182706	81.717795	11.300397
28.5	6.5	9.1386	435.16	0.222975	77.702721	8.946476
28.5	6.6	9.1386	345.65	0.268922	73.115117	7.137691
28.5	6.7	9.1386	275.56	0.320404	67.953579	5.473912
28.5	6.8	9.1386	218.99	0.378920	62.120871	4.111190
28.5	6.9	9.1386	172.34	0.445631	55.434368	3.1587605
28.5	7.0	9.1386	137.61	0.526404	47.353595	2.453475
28.5	7.1	9.1386	109.31	0.622975	37.702721	1.907342
28.5	7.2	9.1386	86.83	0.738382	26.161703	1.440652
28.5	7.3	9.1386	68.86	0.871078	12.83824	1.146586
28.5	7.4	9.1386	54.77	1.022975	7.183339	0.916591
28.5	7.5	9.1386	43.52	1.195042	4.545930	0.732310
28.5	7.6	9.1386	34.57	1.392706	3.454069	0.587605
28.5	7.7	9.1386	27.56	1.616591	2.382755	0.469656
28.5	7.8	9.1386	21.81	1.873595	1.126403	0.377297
28.5	7.9	9.1386	17.22	2.165042	0.833597	0.303432
28.5	8.0	9.1386	13.76	2.495631	0.504368	0.245637
28.5	8.1	9.1386	10.93	2.866404	0.133595	0.199367
28.5	8.2	9.1386	8.68	3.276691	0.072333	0.162598
28.5	8.3	9.1386	6.88	3.726404	0.044144	0.133391
28.5	8.4	9.1386	5.48	4.216591	0.027806	0.110191
28.5	8.5	9.1386	4.35	4.746404	0.017103	0.091763
28.5	8.6	9.1386	3.46	5.316591	0.009125	0.065497
28.5	8.7	9.1386	2.75	5.936404	0.005261	0.048925
28.5	8.8	9.1386	2.18	6.616591	0.003595	0.036397
28.5	8.9	9.1386	1.73	7.356404	0.002403	0.02791
28.5	9.0	9.1386	1.38	8.166404	0.001603	0.021870
28.5	9.1	9.1386	1.09	9.046404	0.001078	0.017707
28.5	9.2	9.1386	0.87	9.996404	0.000721	0.014244
28.5	9.3	9.1386	0.69	11.016404	0.000481	0.011501
28.5	9.4	9.1386	0.55	12.116404	0.000333	0.009481
28.5	9.5	9.1386	0.44	13.296404	0.000233	0.007501
28.5	9.6	9.1386	0.35	14.556404	0.000167	0.006061
28.5	9.7	9.1386	0.27	15.896404	0.000124	0.005061
28.5	9.8	9.1386	0.22	17.316404	0.000091	0.004301
28.5	9.9	9.1386	0.17	18.816404	0.000064	0.003661
28.5	10.0	9.1386	0.14	20.396404	0.000047	0.003157
28.5	10.1	9.1386	0.11	22.056404	0.000033	0.002743
28.5				23.796404	0.000023	0.002423
28.5				25.616404	0.000017	0.002157
28.5				27.516404	0.000012	0.001923
28.5				29.496404	0.000009	0.001723
28.5				31.556404	0.000006	0.001543
28.5				33.696404	0.000004	0.001383
28.5				35.916404	0.000003	0.001243
28.5				38.216404	0.000002	0.001123
28.5				40.596404	0.000001	0.001023
28.5				43.056404	0.000001	0.000943
28.5				45.596404	0.000001	0.000873
28.5				48.216404	0.000001	0.000813
28.5				50.916404	0.000001	0.000763
28.5				53.696404	0.000001	0.000713
28.5				56.556404	0.000001	0.000663
28.5				59.496404	0.000001	0.000613
28.5				62.516404	0.000001	0.000563
28.5				65.616404	0.000001	0.000513
28.5				68.796404	0.000001	0.000463
28.5				72.056404	0.000001	0.000413
28.5				75.396404	0.000001	0.000363
28.5				78.816404	0.000001	0.000313
28.5				82.316404	0.000001	0.000263
28.5				85.896404	0.000001	0.000213
28.5				89.556404	0.000001	0.000163
28.5				93.296404	0.000001	0.000113
28.5				97.116404	0.000001	0.000063
28.5				101.016404	0.000001	0.000013
28.5				105.016404	0.000001	0.000003
28.5				109.096404	0.000001	0.000001
28.5				113.256404	0.000001	0.000001
28.5				117.496404	0.000001	0.000001
28.5				121.816404	0.000001	0.000001
28.5				126.216404	0.000001	0.000001
28.5				130.696404	0.000001	0.000001
28.5				135.256404	0.000001	0.000001
28.5				139.896404	0.000001	0.000001
28.5				144.616404	0.000001	0.000001
28.5				149.416404	0.000001	0.000001
28.5				154.296404	0.000001	0.000001
28.5				159.256404	0.000001	0.000001
28.5				164.296404	0.000001	0.000001
28.5				169.416404	0.000001	0.000001
28.5				174.616404	0.000001	0.000001
28.5				179.896404	0.000001	0.000001
28.5				185.256404	0.000001	0.000001
28.5				190.696404	0.000001	0.000001
28.5				196.216404	0.000001	0.000001
28.5				201.816404	0.000001	0.000001
28.5				207.496404	0.000001	0.000001
28.5				213.256404	0.000001	0.000001
28.5				219.096404	0.000001	0.000001
28.5				224.916404	0.000001	0.000001
28.5				230.816404	0.000001	0.000001
28.5				236.796404	0.000001	0.000001
28.5				242.856404	0.000001	0.000001
28.5				248.996404	0.000001	0.000001
28.5				255.216404	0.000001	0.000001
28.5				261.516404	0.000001	0.000001
28.5				267.896404	0.000001	0.000001
28.5				274.356404	0.000001	0.000001
28.5				280.896404	0.000001	0.000001
28.5				287.516404	0.000001	0.000001
28.5				294.216404	0.000001	0.000001
28.5				300.996404	0.000001	0.000001
28.5				307.856404	0.000001	0.000001
28.5				314.796404	0.000001	0.000001
28.5				321.816404	0.000001	0.000001
28.5				328.916404	0.000001	0.000001
28.5				336.096404	0.000001	0.000001
28.5				343.356404	0.000001	0.000001
28.5				350.696404	0.000001	0.000001
28.5				358.116404	0.000001	0.000001
28.5				365.616404	0.000001	0.000001
28.5				373.196404	0.000001	0.000001
28.5				380.856404	0.000001	0.000001
28.5				388.596404	0.000001	0.000001
28.5				396.416404	0.000001	0.000001
28.5				404.316404	0.000001	0.000001
28.5				412.296404	0.000001	0.000001
28.5				420.356404	0.000001	0.000001
28.5				428.496404	0.000001	0.000001
28.5				436.716404	0.000001	0.000001
28.5				445.016404	0.000001	0.000001
28.5				453.396404	0.000001	0.000001
28.5				461.856404	0.000001	0.000001
28.5				470.396404	0.000001	0.000001
28.5				478.996404	0.000001	0.000001
28.5				487.656404	0.000001	0.000001
28.5				496.356404	0.000001	0.000001
28.5				505.096404	0.000001	0.000001
28.5				513.856404	0.000001	0.000001
28.5				522.656404	0.000001	0.000001
28.5				531.496404	0.000001	0.000001
28.5				540.356404	0.000001	0.000001
28.5				549.256404	0.000001	0.000001
28.5				558.196404	0.000001	0.000001
28.5				567.156404	0.000001	0.000001
28.5				576.156404	0.000001	0.000001
28.5				585.196404	0.000001	0.000001
28.5				594.256404	0.000001	0.000001
28.5				603.356404	0.000001	0.000001
28.5				612.496404	0.000001	0.000001
28.5				621.656404	0.000001	0.000001
28.5				630.856404	0.000001	0.000001
28.5				640.096404	0.000001	0.000001
28.5				649.356404	0.000001	0.000001
28.5				658.656404	0.000001	0.000001
28.5				667.996404	0.000001	0.000001
28.5				677.356404	0.000001	0.000001
28.5				686.756404	0.000001	0.000001
28.5				696.196404	0.000001	0.000001
28.5				705.656404	0.000001	0.000001
28.5				715.156404	0.000001	0.000001
28.5				724.696404	0.000001	0.000001
28.5				734.256404	0.000001	0.000001
28.5				743.856404	0.000001	0.000001
28.5				753.496404	0.000001	0.000001
28.5				763.156404	0.000001	0.000001

Temp C	pH	µM	Ratio	8. UNIONIZED AMMONIA	8. IONIZED AMMONIA	CONCENTRATION OF NH3-N
28.0	5.0	9.1237	132.0036	0.607521	93.492477	273.750732
28.0	5.1	9.1237	1050.004	0.609664	93.490524	217.432713
28.0	5.2	9.1237	8150.18	0.611829	93.488604	172.733307
28.0	5.3	9.1237	6000.04	0.613905	93.486685	137.211313
28.0	5.4	9.1237	5202.60	0.615981	93.484710	108.552339
28.0	5.5	9.1237	4700.07	0.617981	93.482737	86.822397
28.0	5.6	9.1237	3339.41	0.619930	93.480762	68.775099
28.0	5.7	9.1237	2625.54	0.621877	93.478782	54.517422
28.0	5.8	9.1237	2107.03	0.623738	93.476780	43.464344
28.0	5.9	9.1237	1733.58	0.625511	93.474777	34.641613
28.0	6.0	9.1237	1329.55	0.627162	93.472755	27.737497
28.0	6.1	9.1237	1050.02	0.628665	93.470719	21.744099
28.0	6.2	9.1237	838.81	0.630124	93.468670	17.242054
28.0	6.3	9.1237	666.31	0.631555	93.466593	13.734454
28.0	6.4	9.1237	529.27	0.632958	93.464493	10.915205
28.0	6.5	9.1237	420.41	0.634334	93.462369	8.674446
28.0	6.6	9.1237	333.95	0.635685	93.460220	6.805511
28.0	6.7	9.1237	267.26	0.637013	93.458056	5.242353
28.0	6.8	9.1237	210.71	0.638319	93.455874	4.039631
28.0	6.9	9.1237	167.37	0.639594	93.453677	3.166741
28.0	7.0	9.1237	132.95	0.640845	93.451463	2.579594
28.0	7.1	9.1237	105.00	0.642073	93.449235	2.144770
28.0	7.2	9.1237	83.88	0.643279	93.446991	1.747765
28.0	7.3	9.1237	66.63	0.644463	93.444733	1.392534
28.0	7.4	9.1237	52.93	0.645624	93.442455	1.110366
28.0	7.5	9.1237	42.04	0.646762	93.440157	0.866211
28.0	7.6	9.1237	33.40	0.647878	93.437836	0.674154
28.0	7.7	9.1237	26.53	0.648973	93.435497	0.526774
28.0	7.8	9.1237	21.37	0.650048	93.433147	0.414440
28.0	7.9	9.1237	16.74	0.651103	93.430786	0.325210
28.0	8.0	9.1237	12.29	0.652139	93.428416	0.254332
28.0	8.1	9.1237	10.56	0.653154	93.426034	0.200031
28.0	8.2	9.1237	8.34	0.654150	93.423644	0.153310
28.0	8.3	9.1237	6.66	0.655128	93.421244	0.117745
28.0	8.4	9.1237	5.29	0.656089	93.418836	0.094464
28.0	8.5	9.1237	4.20	0.657033	93.416417	0.077155
28.0	8.6	9.1237	3.34	0.657959	93.413991	0.063451
28.0	8.7	9.1237	2.65	0.658868	93.411556	0.052704
28.0	8.8	9.1237	2.11	0.659759	93.409112	0.043976
28.0	8.9	9.1237	1.67	0.660633	93.406661	0.036552
28.0	9.0	9.1237	1.33	0.661491	93.404219	0.030765
28.0	9.1	9.1237	1.04	0.662333	93.401784	0.026334
28.0	9.2	9.1237	0.84	0.663159	93.399351	0.022962
28.0	9.3	9.1237	0.67	0.663968	93.396917	0.020310
28.0	9.4	9.1237	0.53	0.664761	93.394483	0.018144
28.0	9.5	9.1237	0.42	0.665538	93.392055	0.016266
28.0	9.6	9.1237	0.33	0.666300	93.389634	0.014652
28.0	9.7	9.1237	0.27	0.667048	93.387219	0.013252
28.0	9.8	9.1237	0.21	0.667782	93.384814	0.012040
28.0	9.9	9.1237	0.17	0.668502	93.382415	0.011015
28.0	10.0	9.1237	0.13	0.669209	93.380011	0.0102327
28.0	10.1	9.1237	0.11	0.669904	93.377601	0.00962764

CONCENTRATIONS OF AMMONIA (NH3-N) WHICH CONTAIN AN UNIONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

Temp C	pH	pH	Ratio	% Unionized Ammonia	% Ionized Ammonia	Concentration NH ₃
29.5	5.0	9.1087	1285.36	0.007744	99.992256	264.504859
29.5	5.1	9.1087	10291.51	0.004600	99.995399	210.104222
29.5	5.2	9.1087	8196.88	0.012337	98.987662	166.900146
29.5	5.3	9.1087	6437.95	0.015530	98.984469	132.577144
29.5	5.4	9.1087	5113.45	0.019551	98.980448	105.314436
29.5	5.5	9.1087	4062.84	0.024612	97.975387	83.854763
29.5	5.6	9.1087	3229.53	0.030942	96.969057	66.556463
29.5	5.7	9.1087	2503.81	0.038001	96.961999	52.792877
29.5	5.8	9.1087	2032.87	0.046095	95.953904	41.939163
29.5	5.9	9.1087	1617.15	0.054794	94.945205	33.317740
29.5	6.0	9.1087	1244.55	0.064774	93.935225	26.449513
29.5	6.1	9.1087	1020.36	0.077004	92.922995	21.029739
29.5	6.2	9.1087	819.50	0.123229	90.876770	16.704771
29.5	6.3	9.1087	643.80	0.157009	84.298990	13.276493
29.5	6.4	9.1087	511.39	0.195163	80.804836	10.550147
29.5	6.5	9.1087	406.28	0.246124	75.353875	8.385476
29.5	6.6	9.1087	322.95	0.309421	69.691079	6.644306
29.5	6.7	9.1087	250.38	0.380009	61.919990	5.279287
29.5	6.8	9.1087	203.28	0.460954	53.939050	4.193916
29.5	6.9	9.1087	161.71	0.547744	45.222995	3.317740
29.5	7.0	9.1087	124.45	0.647704	35.229995	2.644951
29.5	7.1	9.1087	102.03	0.770004	22.972995	2.102973
29.5	7.2	9.1087	81.95	0.876770	12.322995	1.670477
29.5	7.3	9.1087	64.38	0.951163	4.884836	1.327649
29.5	7.4	9.1087	51.13	0.995163	0.804836	1.055014
29.5	7.5	9.1087	40.62	0.999421	0.053875	0.838547
29.5	7.6	9.1087	32.29	0.999954	0.004836	0.664430
29.5	7.7	9.1087	25.03	0.999990	0.001079	0.527928
29.5	7.8	9.1087	20.32	0.999995	0.000520	0.419391
29.5	7.9	9.1087	16.17	0.999999	0.000229	0.331774
29.5	8.0	9.1087	12.44	0.999999	0.000124	0.264495
29.5	8.1	9.1087	10.20	0.999999	0.000075	0.210297
29.5	8.2	9.1087	8.19	0.999999	0.000048	0.167047
29.5	8.3	9.1087	6.43	0.999999	0.000030	0.132764
29.5	8.4	9.1087	5.11	0.999999	0.000019	0.105501
29.5	8.5	9.1087	4.06	0.999999	0.000012	0.083854
29.5	8.6	9.1087	3.23	0.999999	0.000007	0.066443
29.5	8.7	9.1087	2.56	0.999999	0.000004	0.052792
29.5	8.8	9.1087	2.04	0.999999	0.000002	0.041939
29.5	8.9	9.1087	1.62	0.999999	0.000001	0.033177
29.5	9.0	9.1087	1.29	0.999999	0.000000	0.026449
29.5	9.1	9.1087	1.02	0.999999	0.000000	0.021029
29.5	9.2	9.1087	0.81	0.999999	0.000000	0.016704
29.5	9.3	9.1087	0.64	0.999999	0.000000	0.013276
29.5	9.4	9.1087	0.51	0.999999	0.000000	0.010550
29.5	9.5	9.1087	0.41	0.999999	0.000000	0.008385
29.5	9.6	9.1087	0.32	0.999999	0.000000	0.006644
29.5	9.7	9.1087	0.26	0.999999	0.000000	0.005279
29.5	9.8	9.1087	0.20	0.999999	0.000000	0.004193
29.5	9.9	9.1087	0.16	0.999999	0.000000	0.003317
29.5	10.0	9.1087	0.13	0.999999	0.000000	0.002644
29.5	10.1	9.1087	0.10	0.999999	0.000000	0.002102

CONCENTRATIONS OF AMMONIA (NH₃+NH₄⁺) WHICH CONTAIN AN UNIONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

Temp C	pH	pKa	RATIO	UNIONIZED AMMONIA	IONIZED AMMONIA	CONCENTRATION AMMONIA
30.0	5.0	9.0919	12.616.49	0.004057	92.91943	255.562986
30.0	5.1	9.0919	9459.49	0.010141	92.91943	203.016499
30.0	5.2	9.0919	7936.03	0.012766	92.91943	161.241967
30.0	5.3	9.0919	6211.21	0.016071	92.91943	124.115265
30.0	5.4	9.0919	4911.69	0.020232	92.91943	101.770020
30.0	5.5	9.0919	3925.31	0.025664	92.91943	80.443124
30.0	5.6	9.0919	3119.00	0.032062	92.91943	64.220230
30.0	5.7	9.0919	2476.72	0.040000	92.91943	51.116251
30.0	5.8	9.0919	1967.13	0.050000	92.91943	40.279334
30.0	5.9	9.0919	1562.71	0.063553	92.91943	32.166777
30.0	6.0	9.0919	1241.31	0.080475	92.91943	25.579746
30.0	6.1	9.0919	986.01	0.101215	92.91943	20.122449
30.0	6.2	9.0919	763.21	0.127516	92.91943	16.146957
30.0	6.3	9.0919	622.13	0.160400	92.91943	12.830239
30.0	6.4	9.0919	500.18	0.201404	92.91943	10.165661
30.0	6.5	9.0919	392.54	0.254105	92.91943	8.102447
30.0	6.6	9.0919	311.40	0.321000	92.91943	6.440439
30.0	6.7	9.0919	247.04	0.402130	92.91943	5.120226
30.0	6.8	9.0919	196.74	0.505125	92.91943	4.071383
30.0	6.9	9.0919	156.27	0.635937	92.91943	3.234253
30.0	7.0	9.0919	124.13	0.799159	92.91943	2.576474
30.0	7.1	9.0919	98.60	1.003966	92.91943	2.050405
30.0	7.2	9.0919	76.32	1.250677	92.91943	1.631244
30.0	7.3	9.0919	62.21	1.541434	92.91943	1.301571
30.0	7.4	9.0919	49.42	1.893410	92.91943	1.034111
30.0	7.5	9.0919	39.25	2.444023	92.91943	0.824437
30.0	7.6	9.0919	31.19	3.137432	92.91943	0.650561
30.0	7.7	9.0919	24.77	4.051794	92.91943	0.505675
30.0	7.8	9.0919	19.67	5.370206	92.91943	0.382361
30.0	7.9	9.0919	15.63	7.255229	92.91943	0.276182
30.0	8.0	9.0919	12.41	9.877429	92.91943	0.223614
30.0	8.1	9.0919	9.86	11.320222	92.91943	0.181554
30.0	8.2	9.0919	7.93	13.447612	92.91943	0.146699
30.0	8.3	9.0919	6.22	16.064811	92.91943	0.122344
30.0	8.4	9.0919	5.06	20.302551	92.91943	0.101416
30.0	8.5	9.0919	3.93	24.282452	92.91943	0.084792
30.0	8.6	9.0919	3.12	28.741871	92.91943	0.071499
30.0	8.7	9.0919	2.44	33.699371	92.91943	0.061099
30.0	8.8	9.0919	1.97	39.020203	92.91943	0.052764
30.0	8.9	9.0919	1.56	44.815794	92.91943	0.046150
30.0	9.0	9.0919	1.24	50.351303	92.91943	0.040493
30.0	9.1	9.0919	0.99	56.077523	92.91943	0.036717
30.0	9.2	9.0919	0.74	61.846409	92.91943	0.033400
30.0	9.3	9.0919	0.62	67.825613	92.91943	0.030765
30.0	9.4	9.0919	0.49	71.810406	92.91943	0.028673
30.0	9.5	9.0919	0.31	76.230113	92.91943	0.027010
30.0	9.6	9.0919	0.25	80.144467	92.91943	0.025699
30.0	9.7	9.0919	0.20	83.560054	92.91943	0.024441
30.0	9.8	9.0919	0.16	86.482768	92.91943	0.023408
30.0	9.9	9.0919	0.12	88.957123	92.91943	0.022466
30.0	10.0	9.0919	0.10	91.024506	92.91943	0.021620

.. CONCENTRATIONS OF AMMONIA (NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	pH	pKa	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION mM-NH3
30.5	5.0	9.0791	11746.37	6.000333	99.991653	247.025955
30.5	5.1	9.0791	9529.07	0.010493	99.989507	194.224213
30.5	5.2	9.0791	7569.22	0.013210	99.986789	155.470911
30.5	5.3	9.0791	6012.46	0.016624	99.983376	123.317062
30.5	5.4	9.0791	4775.87	0.020934	99.979065	98.145774
30.5	5.5	9.0791	3743.61	0.026353	99.973647	76.131027
30.5	5.6	9.0791	3013.36	0.033177	99.966822	62.066010
30.5	5.7	9.0791	2393.61	0.041769	99.958231	49.305044
30.5	5.8	9.0791	1901.32	0.052567	99.947433	39.147114
30.5	5.9	9.0791	1510.27	0.066167	99.933833	31.117046
30.5	6.0	9.0791	1194.65	0.083264	99.916736	24.721464
30.5	6.1	9.0791	952.02	0.104431	99.895569	19.461220
30.5	6.2	9.0791	756.93	0.131934	99.868065	15.605837
30.5	6.3	9.0791	601.25	0.164443	99.835556	12.400406
30.5	6.4	9.0791	477.59	0.202940	99.797059	9.854233
30.5	6.5	9.0791	374.37	0.247607	99.752393	7.831740
30.5	6.6	9.0791	301.36	0.300751	99.699249	6.252217
30.5	6.7	9.0791	239.36	0.364034	99.635965	4.949108
30.5	6.8	9.0791	190.13	0.439192	99.560807	3.935456
30.5	6.9	9.0791	151.03	0.523192	99.476807	3.139244
30.5	7.0	9.0791	119.97	0.617764	99.382235	2.460711
30.5	7.1	9.0791	95.29	0.726671	99.273325	1.942681
30.5	7.2	9.0791	75.64	1.034442	98.965502	1.259134
30.5	7.3	9.0791	60.13	1.303674	98.696326	1.003964
30.5	7.4	9.0791	47.76	1.635461	98.364539	0.791716
30.5	7.5	9.0791	37.46	2.050861	97.949127	0.641061
30.5	7.6	9.0791	30.13	2.564241	97.431747	0.513449
30.5	7.7	9.0791	24.94	3.211661	96.788132	0.412082
30.5	7.8	9.0791	19.01	4.016134	95.986553	0.331564
30.5	7.9	9.0791	15.10	4.995576	95.003414	0.267605
30.5	8.0	9.0791	12.09	6.209973	93.790024	0.214402
30.5	8.1	9.0791	9.53	7.894166	92.305832	0.176447
30.5	8.2	9.0791	7.37	10.09252	89.330736	0.144331
30.5	8.3	9.0791	6.01	12.259444	85.740163	0.116929
30.5	8.4	9.0791	4.78	17.317420	82.667180	0.094704
30.5	8.5	9.0791	3.81	20.648413	79.351587	0.082638
30.5	8.6	9.0791	3.09	24.915894	75.084106	0.069476
30.5	8.7	9.0791	2.59	30.442244	70.553752	0.059740
30.5	8.8	9.0791	2.19	36.966156	65.533844	0.051484
30.5	8.9	9.0791	1.91	44.935112	60.164888	0.045292
30.5	9.0	9.0791	1.70	54.960774	54.939322	0.040211
30.5	9.1	9.0791	1.55	67.201449	48.795654	0.036176
30.5	9.2	9.0791	1.44	82.916367	43.083633	0.032970
30.5	9.3	9.0791	1.34	102.459104	37.549496	0.030424
30.5	9.4	9.0791	1.26	127.67727	32.323273	0.028401
30.5	9.5	9.0791	1.19	159.442116	27.503764	0.026795
30.5	9.6	9.0791	1.13	199.30114	23.156942	0.025419
30.5	9.7	9.0791	1.07	249.645883	19.314117	0.024505
30.5	9.8	9.0791	1.02	312.023605	15.876395	0.023700
30.5	9.9	9.0791	0.97	389.676246	13.121704	0.023060
30.5	10.0	9.0791	0.92	489.287994	10.712604	0.022552
30.5	10.1	9.0791	0.88	612.99434	8.788542	

** CONCENTRATIONS OF AMMONIA (NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 mM/L NH3-4

Temp C	PH	pH	RATIO	AMMONIATED AMMONIA	UNIONIZED AMMONIA	CONCENTRATION
31.0	5.0	0.0663	11575.11	0.008626	0.008626	238.763001
31.0	5.1	0.0663	9210.33	0.010855	0.010855	189.661301
31.0	5.2	0.0663	7216.06	0.013667	0.013667	150.657637
31.0	5.3	0.0663	5811.34	0.017709	0.017709	119.676102
31.0	5.4	0.0663	4616.12	0.021659	0.021659	95.066513
31.0	5.5	0.0663	3660.72	0.027262	0.027262	75.518387
31.0	5.6	0.0663	2912.58	0.034322	0.034322	59.400444
31.0	5.7	0.0663	2311.55	0.043203	0.043203	47.656570
31.0	5.8	0.0663	1837.72	0.054386	0.054386	37.656234
31.0	5.9	0.0663	1455.76	0.068654	0.068654	30.076450
31.0	6.0	0.0663	1159.53	0.086168	0.086168	23.845233
31.0	6.1	0.0663	921.05	0.106455	0.106455	18.944924
31.0	6.2	0.0663	721.61	0.130697	0.130697	15.044522
31.0	6.3	0.0663	581.14	0.157774	0.157774	11.944115
31.0	6.4	0.0663	461.62	0.216161	0.216161	9.525105
31.0	6.5	0.0663	366.06	0.271979	0.271979	7.570463
31.0	6.6	0.0663	291.26	0.342158	0.342158	6.017674
31.0	6.7	0.0663	231.16	0.430371	0.430371	4.784253
31.0	6.8	0.0663	183.77	0.541200	0.541200	3.805004
31.0	6.9	0.0663	145.94	0.680379	0.680379	3.026267
31.0	7.0	0.0663	115.95	0.856132	0.856132	2.401088
31.0	7.1	0.0663	92.11	1.074065	1.074065	1.917051
31.0	7.2	0.0663	72.16	1.343392	1.343392	1.527002
31.0	7.3	0.0663	58.11	1.651614	1.651614	1.217177
31.0	7.4	0.0663	46.16	2.122231	2.122231	0.971075
31.0	7.5	0.0663	36.57	2.658754	2.658754	0.775598
31.0	7.6	0.0663	29.13	3.314324	3.314324	0.620107
31.0	7.7	0.0663	23.14	4.14566	4.14566	0.506963
31.0	7.8	0.0663	18.38	5.161096	5.161096	0.396987
31.0	7.9	0.0663	14.56	6.411096	6.411096	0.31162
31.0	8.0	0.0663	11.56	7.919284	7.919284	0.249343
31.0	8.1	0.0663	9.21	9.743642	9.743642	0.210238
31.0	8.2	0.0663	7.32	12.024528	12.024528	0.171233
31.0	8.3	0.0663	5.81	14.880442	14.880442	0.140250
31.0	8.4	0.0663	4.62	17.805281	17.805281	0.115660
31.0	8.5	0.0663	3.67	21.827628	21.827628	0.094091
31.0	8.6	0.0663	2.91	26.957770	26.957770	0.080363
31.0	8.7	0.0663	2.31	33.174234	33.174234	0.068228
31.0	8.8	0.0663	1.84	40.653442	40.653442	0.058430
31.0	8.9	0.0663	1.46	49.305405	49.305405	0.050648
31.0	9.0	0.0663	1.16	59.253955	59.253955	0.044466
31.0	9.1	0.0663	0.92	71.768595	71.768595	0.039555
31.0	9.2	0.0663	0.73	87.244440	87.244440	0.035555
31.0	9.3	0.0663	0.56	106.41654	106.41654	0.032556
31.0	9.4	0.0663	0.44	131.149384	131.149384	0.030095
31.0	9.5	0.0663	0.37	164.2480	164.2480	0.028140
31.0	9.6	0.0663	0.29	211.0341	211.0341	0.026587
31.0	9.7	0.0663	0.23	280.675637	280.675637	0.025354
31.0	9.8	0.0663	0.18	371.261337	371.261337	0.024374
31.0	9.9	0.0663	0.15	491.609085	491.609085	0.023596
31.0	10.0	0.0663	0.12	651.565887	651.565887	0.022974
31.0	10.1	0.0663	0.09			0.022487

CONCENTRATIONS OF AMMONIA (NH₄-N) WHICH CONTAIN AN UNIONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	pH	pH A	RATIO	A UNIONIZED AMMONIA	B IONIZED AMMONIA	CONCENTRATION (mg/L)
31.5	5.0	9.0496	1120.54	0.00921	64.941074	270.405535
31.5	5.1	9.0496	863.27	0.011231	49.940773	183.315424
31.5	5.2	9.0496	702.13	0.014134	40.945455	145.635764
31.5	5.3	9.0496	541.76	0.017793	34.942191	115.646401
31.5	5.4	9.0496	422.22	0.022405	29.947545	91.497751
31.5	5.5	9.0496	350.97	0.024205	25.947180	73.601312
31.5	5.6	9.0496	285.48	0.035532	21.946643	57.941333
31.5	5.7	9.0496	225.62	0.046494	18.9455292	46.064451
31.5	5.8	9.0496	176.85	0.056600	16.943726	36.597753
31.5	5.9	9.0496	141.09	0.0670817	14.9429169	29.076905
31.5	6.0	9.0496	112.87	0.079137	12.9410854	23.099244
31.5	6.1	9.0496	89.36	0.112191	10.9404802	14.152674
31.5	6.2	9.0496	70.22	0.141199	9.94050745	14.582294
31.5	6.3	9.0496	56.177	0.17693	8.94022246	11.547341
31.5	6.4	9.0496	46.23	0.223544	7.94016344	9.208434
31.5	6.5	9.0496	38.65	0.271332	6.940072	7.318745
31.5	6.6	9.0496	32.65	0.32917	6.0455440	5.417745
31.5	6.7	9.0496	28.05	0.385147	5.24540231	4.625440
31.5	6.8	9.0496	24.64	0.439761	4.54540231	3.878348
31.5	6.9	9.0496	17.65	0.503676	3.9449310	2.926063
31.5	7.0	9.0496	14.11	0.564263	3.4449310	2.320692
31.5	7.1	9.0496	11.09	0.6110676	3.0449310	1.953423
31.5	7.2	9.0496	8.70	0.64243	2.7449310	1.676781
31.5	7.3	9.0496	6.82	0.651454	2.5449310	1.472285
31.5	7.4	9.0496	5.46	0.64802	2.4449310	1.343487
31.5	7.5	9.0496	4.46	0.629874	2.3449310	1.244081
31.5	7.6	9.0496	3.76	0.617574	2.2449310	1.144081
31.5	7.7	9.0496	3.26	0.60962	2.1449310	1.044081
31.5	7.8	9.0496	2.86	0.6017574	2.0449310	0.944081
31.5	7.9	9.0496	2.56	0.59382	1.9449310	0.844081
31.5	8.0	9.0496	2.36	0.58582	1.8449310	0.744081
31.5	8.1	9.0496	2.16	0.57782	1.7449310	0.644081
31.5	8.2	9.0496	2.06	0.56982	1.6449310	0.544081
31.5	8.3	9.0496	1.96	0.56182	1.5449310	0.444081
31.5	8.4	9.0496	1.86	0.55382	1.4449310	0.344081
31.5	8.5	9.0496	1.76	0.54582	1.3449310	0.244081
31.5	8.6	9.0496	1.66	0.53782	1.2449310	0.144081
31.5	8.7	9.0496	1.56	0.52982	1.1449310	0.044081
31.5	8.8	9.0496	1.46	0.52182	1.0449310	0.044081
31.5	8.9	9.0496	1.36	0.51382	0.9449310	0.044081
31.5	9.0	9.0496	1.26	0.50582	0.8449310	0.044081
31.5	9.1	9.0496	1.16	0.49782	0.7449310	0.044081
31.5	9.2	9.0496	1.06	0.48982	0.6449310	0.044081
31.5	9.3	9.0496	0.96	0.48182	0.5449310	0.044081
31.5	9.4	9.0496	0.86	0.47382	0.4449310	0.044081
31.5	9.5	9.0496	0.76	0.46582	0.3449310	0.044081
31.5	9.6	9.0496	0.66	0.45782	0.2449310	0.044081
31.5	9.7	9.0496	0.56	0.44982	0.1449310	0.044081
31.5	9.8	9.0496	0.46	0.44182	0.0449310	0.044081
31.5	9.9	9.0496	0.36	0.43382	0.0449310	0.044081
31.5	10.0	9.0496	0.26	0.42582	0.0449310	0.044081
31.5	10.1	9.0496	0.16	0.41782	0.0449310	0.044081

CONCENTRATIONS OF AMMONIA (mg/L) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	pH	PPA	RATIO	A UNIONIZED AMMONIA	B IONIZED AMMONIA	CONCENTRATION, mg/L
32.0	5.0	9.0349	16635.05	0.009224	99.910768	223.13445
32.0	5.1	9.0349	6607.39	0.011617	99.988373	177.264457
32.0	5.2	9.0349	6637.11	0.016628	99.983367	160.716661
32.0	5.3	9.0349	5430.91	0.016610	99.984533	111.463002
32.0	5.4	9.0349	4313.93	0.021175	99.978822	88.484442
32.0	5.5	9.0349	3626.68	0.029178	99.970825	70.575084
32.0	5.6	9.0349	2721.92	0.036722	99.963212	56.008819
32.0	5.7	9.0349	2162.10	0.044240	99.955366	44.531162
32.0	5.8	9.0349	1717.82	0.051413	99.941403	35.362202
32.0	5.9	9.0349	1364.20	0.057253	99.926743	28.104369
32.0	6.0	9.0349	1083.62	0.062198	99.907791	22.132321
32.0	6.1	9.0349	860.75	0.114063	99.884397	17.743654
32.0	6.2	9.0349	663.72	0.186072	99.813943	14.064370
32.0	6.3	9.0349	543.10	0.183790	99.816208	11.202991
32.0	6.4	9.0349	431.90	0.231283	99.768723	8.903694
32.0	6.5	9.0349	362.67	0.290974	99.709015	7.076227
32.0	6.6	9.0349	272.20	0.366034	99.633937	5.625042
32.0	6.7	9.0349	216.21	0.440378	99.539612	4.472404
32.0	6.8	9.0349	171.78	0.574441	99.421097	3.556401
32.0	6.9	9.0349	136.42	0.727644	99.272339	2.829506
32.0	7.0	9.0349	108.35	0.918363	99.085617	2.251792
32.0	7.1	9.0349	86.09	1.149918	99.951579	1.792400
32.0	7.2	9.0349	66.37	1.441444	99.556502	1.424384
32.0	7.3	9.0349	54.31	1.807971	99.182017	1.138645
32.0	7.4	9.0349	43.14	2.266592	98.736497	0.874453
32.0	7.5	9.0349	36.27	2.835444	98.164551	0.724153
32.0	7.6	9.0349	27.22	3.543597	97.456340	0.581345
32.0	7.7	9.0349	21.62	4.420569	96.579437	0.465774
32.0	7.8	9.0349	17.17	5.502172	95.597814	0.374216
32.0	7.9	9.0349	13.66	6.849521	94.170471	0.301485
32.0	8.0	9.0349	10.86	8.498449	91.551544	0.243713
32.0	8.1	9.0349	8.61	10.408270	89.591721	0.197823
32.0	8.2	9.0349	6.84	12.754358	87.240631	0.161372
32.0	8.3	9.0349	5.43	15.549358	84.550634	0.124417
32.0	8.4	9.0349	4.31	18.817813	81.182190	0.109414
32.0	8.5	9.0349	3.43	22.545554	77.410448	0.091148
32.0	8.6	9.0349	2.72	26.67063	73.132415	0.076637
32.0	8.7	9.0349	2.16	31.423672	68.376324	0.065109
32.0	8.8	9.0349	1.72	36.744676	63.201324	0.055953
32.0	8.9	9.0349	1.36	42.746677	57.703323	0.049680
32.0	9.0	9.0349	1.08	47.942352	52.007645	0.042403
32.0	9.1	9.0349	0.86	53.746707	46.255293	0.036316
32.0	9.2	9.0349	0.68	59.313227	40.606673	0.030468
32.0	9.3	9.0349	0.54	64.753757	35.198243	0.024973
32.0	9.4	9.0349	0.43	69.02057	30.131445	0.020746
32.0	9.5	9.0349	0.36	74.077534	25.522461	0.016195
32.0	9.6	9.0349	0.27	78.903592	21.396409	0.0125042
32.0	9.7	9.0349	0.22	82.221999	17.778091	0.009426
32.0	9.8	9.0349	0.17	85.442251	14.657639	0.007399
32.0	9.9	9.0349	0.14	87.945087	12.006413	0.005821
32.0	10.0	9.0349	0.11	90.222748	9.777522	0.0042367
32.0	10.1	9.0349	0.09	92.076280	7.925720	

CONCENTRATIONS OF AMMONIA IN mg/L WHICH CONTAIN AN UNIONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	pH	RATIO	UNIONIZED AMMONIA	IONIZED AMMONIA	CONCENTRATION
32.5	5.0	9.0202	10077.11	0.009700	99.990299	215.74223
32.5	5.1	9.0202	8322.29	0.012010	99.987989	171.376221
32.5	5.2	9.0202	6619.63	0.015120	99.984879	136.113459
32.5	5.3	9.0202	5251.07	0.019000	99.980999	109.139038
32.5	5.4	9.0202	4171.06	0.023660	99.976339	85.902783
32.5	5.5	9.0202	3313.16	0.029170	99.970820	68.234537
32.5	5.6	9.0202	2631.75	0.037460	99.964539	54.208374
32.5	5.7	9.0202	2093.53	0.049100	99.956900	43.063534
32.5	5.8	9.0202	1668.53	0.064100	99.945900	34.218861
32.5	5.9	9.0202	1319.61	0.083700	99.930300	27.174960
32.5	6.0	9.0202	1007.71	0.108100	99.891900	21.542762
32.5	6.1	9.0202	832.29	0.139000	99.861000	17.156003
32.5	6.2	9.0202	661.96	0.176000	99.824000	13.632605
32.5	6.3	9.0202	525.10	0.219000	99.781000	10.832581
32.5	6.4	9.0202	417.10	0.269000	99.731000	8.604477
32.5	6.5	9.0202	331.31	0.326000	99.674000	6.842505
32.5	6.6	9.0202	263.17	0.391000	99.609000	5.439445
32.5	6.7	9.0202	209.35	0.464000	99.536000	4.324044
32.5	6.8	9.0202	166.85	0.546000	99.454000	3.419665
32.5	6.9	9.0202	131.96	0.637000	99.363000	2.736482
32.5	7.0	9.0202	100.77	0.737000	99.263000	2.217487
32.5	7.1	9.0202	83.23	0.846000	99.154000	1.734195
32.5	7.2	9.0202	66.19	0.964000	99.036000	1.317577
32.5	7.3	9.0202	52.51	1.091000	98.911000	1.004300
32.5	7.4	9.0202	41.71	1.227000	98.778000	0.762192
32.5	7.5	9.0202	33.13	1.372000	98.638000	0.562483
32.5	7.6	9.0202	26.32	1.527000	98.493000	0.410331
32.5	7.7	9.0202	20.91	1.692000	98.343000	0.302502
32.5	7.8	9.0202	16.61	1.867000	98.188000	0.227181
32.5	7.9	9.0202	13.19	2.052000	98.028000	0.173323
32.5	8.0	9.0202	10.08	2.247000	97.863000	0.131953
32.5	8.1	9.0202	8.32	2.452000	97.693000	0.100475
32.5	8.2	9.0202	6.61	2.667000	97.518000	0.077400
32.5	8.3	9.0202	5.25	2.892000	97.338000	0.063635
32.5	8.4	9.0202	4.31	3.127000	97.153000	0.054782
32.5	8.5	9.0202	3.63	3.372000	96.963000	0.048749
32.5	8.6	9.0202	3.09	3.627000	96.768000	0.044705
32.5	8.7	9.0202	2.66	3.892000	96.568000	0.042164
32.5	8.8	9.0202	2.32	4.167000	96.363000	0.037727
32.5	8.9	9.0202	2.05	4.452000	96.153000	0.034202
32.5	9.0	9.0202	1.85	4.747000	95.938000	0.031402
32.5	9.1	9.0202	1.65	5.052000	95.718000	0.029179
32.5	9.2	9.0202	1.45	5.367000	95.493000	0.027412
32.5	9.3	9.0202	1.25	5.692000	95.263000	0.026089
32.5	9.4	9.0202	1.05	6.027000	95.028000	0.024495
32.5	9.5	9.0202	0.85	6.372000	94.788000	0.022409
32.5	9.6	9.0202	0.65	6.727000	94.543000	0.023306
32.5	9.7	9.0202	0.45	7.092000	94.293000	0.022747
32.5	9.8	9.0202	0.25	7.467000	94.038000	0.022304
32.5	9.9	9.0202	0.15	7.852000	93.778000	0.022350
32.5	10.0	9.0202	0.08	8.247000	93.513000	0.022304
32.5	10.1	9.0202	0.00	8.652000	93.243000	0.022304

CONCENTRATIONS OF AMMONIA (mg/L) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	pKa	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH ₄ ⁺ M ³
33.0	5.0	9.0057	10131.16	0.004873	99.995128	208.521109
33.0	5.1	9.0057	8047.47	0.012425	99.987564	165.714079
33.0	5.2	9.0057	6392.34	0.015641	99.984354	131.616901
33.0	5.3	9.0057	5077.63	0.019640	99.980361	104.548954
33.0	5.4	9.0057	4033.31	0.024747	99.975253	83.066422
33.0	5.5	9.0057	3203.78	0.031203	99.968796	65.986324
33.0	5.6	9.0057	2544.85	0.039740	99.960259	52.419113
33.0	5.7	9.0057	2021.45	0.049443	99.950556	41.642273
33.0	5.8	9.0057	1605.70	0.062234	99.937759	33.041494
33.0	5.9	9.0057	1275.45	0.078342	99.921656	26.282166
33.0	6.0	9.0057	1014.13	0.098607	99.901392	20.480420
33.0	6.1	9.0057	804.16	0.121017	99.878985	16.590561
33.0	6.2	9.0057	634.24	0.151191	99.848809	13.182410
33.0	6.3	9.0057	507.77	0.189553	99.810446	10.475570
33.0	6.4	9.0057	403.34	0.247314	99.752686	8.325284
33.0	6.5	9.0057	320.34	0.311159	99.688843	6.617253
33.0	6.6	9.0057	254.69	0.391407	99.608592	5.240510
33.0	6.7	9.0057	202.15	0.482252	99.517736	4.182413
33.0	6.8	9.0057	160.57	0.614514	99.385486	3.326765
33.0	6.9	9.0057	127.55	0.777425	99.222574	2.646783
33.0	7.0	9.0057	101.31	0.977340	99.022660	2.106651
33.0	7.1	9.0057	80.48	1.221341	98.778659	1.677610
33.0	7.2	9.0057	63.93	1.543233	98.456763	1.336810
33.0	7.3	9.0057	50.78	1.931334	98.068665	1.046102
33.0	7.4	9.0057	40.33	2.419308	97.580688	0.841070
33.0	7.5	9.0057	32.04	3.026750	96.973236	0.680265
33.0	7.6	9.0057	25.45	3.780424	96.219162	0.544589
33.0	7.7	9.0057	20.22	4.713633	95.286362	0.436818
33.0	7.8	9.0057	16.06	5.862552	94.137436	0.351212
33.0	7.9	9.0057	12.75	7.270144	92.729443	0.283213
33.0	8.0	9.0057	10.13	8.963454	91.036541	0.229199
33.0	8.1	9.0057	8.05	11.052402	88.947546	0.186294
33.0	8.2	9.0057	6.39	13.527922	86.472477	0.152214
33.0	8.3	9.0057	5.04	16.453232	83.546769	0.125143
33.0	8.4	9.0057	4.03	19.866944	80.133011	0.103639
33.0	8.5	9.0057	3.20	23.787394	76.212601	0.086558
33.0	8.6	9.0057	2.54	28.209075	71.790924	0.072491
33.0	8.7	9.0057	2.02	33.095744	66.904251	0.062213
33.0	8.8	9.0057	1.61	38.376450	61.623550	0.053653
33.0	8.9	9.0057	1.28	43.946274	56.053726	0.046453
33.0	9.0	9.0057	1.01	49.672667	50.327133	0.041451
33.0	9.1	9.0057	0.80	55.608051	44.391949	0.037161
33.0	9.2	9.0057	0.64	61.002792	38.997208	0.033753
33.0	9.3	9.0057	0.51	66.322205	33.677795	0.031045
33.0	9.4	9.0057	0.40	71.257919	28.742081	0.028495
33.0	9.5	9.0057	0.32	75.734940	24.265060	0.027187
33.0	9.6	9.0057	0.25	79.713120	20.286880	0.025830
33.0	9.7	9.0057	0.20	83.163864	16.836132	0.024752
33.0	9.8	9.0057	0.16	86.163845	13.836105	0.023896
33.0	9.9	9.0057	0.13	88.687698	11.312302	0.023216
33.0	10.0	9.0057	0.10	90.800262	9.197738	0.022676
33.0	10.1	9.0057	0.08	92.551483	7.448517	0.022247

CONCENTRATIONS OF AMMONIA (NH₄⁺ M³) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH₃-N

TEMP C	pH	pKa	RATIO	% IONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+NH3
33.5	5.0	8.9911	9797.72	0.010205	99.989792	201.755707
33.5	5.1	8.9911	7742.62	0.012447	99.987552	160.284679
33.5	5.2	8.9911	6181.95	0.01173	99.988266	127.307129
33.5	5.3	8.9911	4810.52	0.020360	99.979639	101.126078
33.5	5.4	8.9911	3980.56	0.025631	99.974368	80.331176
33.5	5.5	8.9911	3098.33	0.032605	99.967394	63.415231
33.5	5.6	8.9911	2461.10	0.040616	99.959384	50.694550
33.5	5.7	8.9911	1954.92	0.051127	99.948872	40.272400
33.5	5.8	8.9911	1552.45	0.064350	99.935649	31.903790
33.5	5.9	8.9911	1233.48	0.081006	99.918991	25.417447
33.5	6.0	8.9911	979.79	0.101954	99.898045	20.194364
33.5	6.1	8.9911	775.27	0.124325	99.875674	16.045212
33.5	6.2	8.9911	618.20	0.14947	99.850501	12.749427
33.5	6.3	8.9911	491.05	0.201224	99.798776	10.131456
33.5	6.4	8.9911	390.06	0.255714	99.744284	8.051455
33.5	6.5	8.9911	307.84	0.321712	99.678284	6.400134
33.5	6.6	8.9911	246.11	0.404673	99.595322	5.048957
33.5	6.7	8.9911	195.49	0.50919	99.49079	4.045427
33.5	6.8	8.9911	152.29	0.639847	99.360153	3.217954
33.5	6.9	8.9911	123.35	0.804187	99.195801	2.540350
33.5	7.0	8.9911	97.98	1.010305	98.989685	2.037497
33.5	7.1	8.9911	77.83	1.268540	98.731415	1.623074
33.5	7.2	8.9911	61.82	1.591817	98.408173	1.293490
33.5	7.3	8.9911	49.11	1.995759	97.994242	1.031642
33.5	7.4	8.9911	39.01	2.490581	97.509412	0.823734
33.5	7.5	8.9911	30.94	3.126566	96.873444	0.658454
33.5	7.6	8.9911	24.61	3.964475	96.035520	0.527344
33.5	7.7	8.9911	19.55	4.966241	95.033759	0.423119
33.5	7.8	8.9911	15.53	6.049947	93.949997	0.340331
33.5	7.9	8.9911	12.34	7.499009	92.500977	0.274570
33.5	8.0	8.9911	9.80	9.260873	90.739120	0.222333
33.5	8.1	8.9911	7.78	11.345717	88.654273	0.180441
33.5	8.2	8.9911	6.18	13.923245	85.076706	0.147442
33.5	8.3	8.9911	4.91	16.918427	83.091573	0.121702
33.5	8.4	8.9911	3.90	20.405136	79.594864	0.100906
33.5	8.5	8.9911	3.10	24.349399	75.650601	0.084387
33.5	8.6	8.9911	2.46	28.841724	71.158276	0.071266
33.5	8.7	8.9911	1.96	33.940912	66.159044	0.060444
33.5	8.8	8.9911	1.55	39.170894	60.829102	0.052565
33.5	8.9	8.9911	1.23	44.772247	55.227753	0.045988
33.5	9.0	8.9911	0.98	50.509476	49.490524	0.040765
33.5	9.1	8.9911	0.74	56.233337	43.766663	0.036415
33.5	9.2	8.9911	0.62	61.795914	38.204086	0.033319
33.5	9.3	8.9911	0.49	67.065594	32.934402	0.030701
33.5	9.4	8.9911	0.39	71.938416	28.061584	0.028622
33.5	9.5	8.9911	0.31	76.346420	23.653580	0.026970
33.5	9.6	8.9911	0.25	80.248871	19.751129	0.025658
33.5	9.7	8.9911	0.20	83.646435	16.353165	0.024615
33.5	9.8	8.9911	0.16	86.558090	13.441910	0.023787
33.5	9.9	8.9911	0.12	89.019135	10.980865	0.023130
33.5	10.0	8.9911	0.10	91.076050	8.923950	0.022607
33.5	10.1	8.9911	0.08	92.776900	7.221100	0.022193

** CONCENTRATIONS OF AMMONIA(NH4+NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	PRA	RATIO	A UNIONIZED AMMONIA	R IONIZED AMMONIA	CONCENTRATION NH4+NM3
34.0	5.0	A.9766	9476.27	0.010552	99.949441	195.137624
34.0	5.1	A.9766	7527.29	0.013253	99.946710	155.007355
34.0	5.2	A.9766	5974.14	0.016722	99.943276	123.131130
34.0	5.3	A.9766	4749.41	0.021051	99.978943	97.410944
34.0	5.4	A.9766	3772.60	0.025700	99.973475	77.698314
34.0	5.5	A.9766	2996.64	0.033354	99.966629	61.722290
34.0	5.6	A.9766	2360.35	0.041943	99.954008	49.032074
34.0	5.7	A.9766	1850.74	0.052860	99.947128	34.951443
34.0	5.8	A.9766	1501.90	0.065374	99.933456	30.464809
34.0	5.9	A.9766	1193.01	0.081352	99.916245	24.544610
34.0	6.0	A.9766	947.64	0.105414	99.894577	19.532501
34.0	6.1	A.9766	752.74	0.132672	99.873329	15.519482
34.0	6.2	A.9766	597.52	0.210107	99.833923	12.331820
34.0	6.3	A.9766	474.95	0.244365	99.789896	9.799760
34.0	6.4	A.9766	377.26	0.332544	99.735626	7.788467
34.0	6.5	A.9766	299.67	0.418343	99.674704	6.130444
34.0	6.6	A.9766	236.04	0.513443	99.591650	4.921802
34.0	6.7	A.9766	185.04	0.614042	99.473407	3.913766
34.0	6.8	A.9766	150.19	0.731234	99.338593	3.113053
34.0	6.9	A.9766	119.30	0.882114	99.169747	2.477025
34.0	7.0	A.9766	94.77	1.111047	99.955780	1.971409
34.0	7.1	A.9766	75.27	1.344924	99.668950	1.570500
34.0	7.2	A.9766	59.74	1.644924	99.352072	1.251729
34.0	7.3	A.9766	47.50	2.052051	97.937443	0.998520
34.0	7.4	A.9766	37.73	2.542174	97.417816	0.797389
34.0	7.5	A.9766	29.97	3.224177	96.770813	0.637624
34.0	7.6	A.9766	23.80	4.031580	95.968414	0.510718
34.0	7.7	A.9766	18.91	5.023016	94.976974	0.409913
34.0	7.8	A.9766	15.02	6.242404	93.757546	0.329841
34.0	7.9	A.9766	11.93	7.733712	92.266231	0.266237
34.0	8.0	A.9766	9.44	9.545019	90.454971	0.215715
34.0	8.1	A.9766	7.53	11.726832	88.273361	0.175583
34.0	8.2	A.9766	5.98	14.327844	85.672089	0.143706
34.0	8.3	A.9766	4.75	17.392502	82.607499	0.118384
34.0	8.4	A.9766	3.77	20.752266	79.047714	0.094271
34.0	8.5	A.9766	3.00	25.014944	74.940011	0.072294
34.0	8.6	A.9766	2.38	29.581844	70.418152	0.054603
34.0	8.7	A.9766	1.89	34.591751	65.403249	0.045523
34.0	8.8	A.9766	1.50	40.454536	60.031464	0.035156
34.0	8.9	A.9766	1.19	45.594634	54.401546	0.025155
34.0	9.0	A.9766	0.95	51.343140	48.656860	0.010103
34.0	9.1	A.9766	0.75	57.052567	42.947433	0.003490
34.0	9.2	A.9766	0.60	62.580292	37.419708	0.002902
34.0	9.3	A.9766	0.47	67.798124	32.201874	0.003070
34.0	9.4	A.9766	0.38	72.606857	27.393143	0.002354
34.0	9.5	A.9766	0.30	76.941742	21.058258	0.002761
34.0	9.6	A.9766	0.24	80.772324	19.227676	0.002549
34.0	9.7	A.9766	0.19	84.097992	17.902008	0.002483
34.0	9.8	A.9766	0.15	86.941544	16.058456	0.002383
34.0	9.9	A.9766	0.12	89.341019	13.658981	0.002307
34.0	10.0	A.9766	0.09	91.343506	10.656494	0.002254
34.0	10.1	A.9766	0.08	92.499252	7.600749	0.002210

CONCENTRATIONS OF AMMONIA (NH4+NM3) WHICH CONTAIN AN UNIONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	PH	pH	RATIO	% IONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4-NH3
34.5	5.0	A.9622	9166.37	0.010904	94.989090	188.756180
34.5	5.1	A.9622	7281.12	0.013732	90.986267	149.938765
34.5	5.2	A.9622	5783.69	0.017287	90.962712	119.104950
34.5	5.3	A.9622	4544.39	0.021762	93.978226	94.612404
34.5	5.4	A.9622	3649.22	0.027396	94.972595	75.157944
34.5	5.5	A.9622	2896.69	0.034447	94.965500	59.704391
34.5	5.6	A.9622	2306.51	0.043412	94.956589	47.429184
34.5	5.7	A.9622	1828.55	0.054645	94.945343	37.478635
34.5	5.8	A.9622	1456.79	0.068785	94.931213	29.933502
34.5	5.9	A.9622	1153.99	0.086581	94.913406	23.781281
34.5	6.0	A.9622	916.65	0.104974	94.891022	18.894379
34.5	6.1	A.9622	728.12	0.137151	94.862839	15.012404
34.5	6.2	A.9622	578.37	0.172682	94.827393	11.924190
34.5	6.3	A.9622	454.41	0.217195	94.782791	9.479439
34.5	6.4	A.9622	364.93	0.273279	94.726715	7.534426
34.5	6.5	A.9622	289.67	0.343746	94.655204	5.969056
34.5	6.6	A.9622	230.25	0.424229	94.567566	4.745116
34.5	6.7	A.9622	182.90	0.523782	94.456207	3.786447
34.5	6.8	A.9622	145.28	0.643617	94.316376	3.011921
34.5	6.9	A.9622	115.40	0.7894101	94.140884	2.396689
34.5	7.0	A.9622	91.67	1.079143	94.920853	1.907995
34.5	7.1	A.9622	72.81	1.354773	94.645218	1.519812
34.5	7.2	A.9622	57.94	1.699593	94.309400	1.211464
34.5	7.3	A.9622	45.94	2.130243	97.859705	0.966534
34.5	7.4	A.9622	36.49	2.667152	97.332840	0.771984
34.5	7.5	A.9622	28.99	3.334712	96.645283	0.617445
34.5	7.6	A.9622	23.03	4.162210	95.837784	0.494493
34.5	7.7	A.9622	18.29	5.146038	94.815944	0.397180
34.5	7.8	A.9622	14.53	6.439870	93.560120	0.314727
34.5	7.9	A.9622	11.54	7.974337	92.025650	0.258203
34.5	8.0	A.9622	9.17	9.835933	90.164001	0.209333
34.5	8.1	A.9622	7.28	12.075234	87.924759	0.170514
34.5	8.2	A.9622	5.78	14.749912	85.259479	0.139679
34.5	8.3	A.9622	4.59	17.875412	82.124588	0.115186
34.5	8.4	A.9622	3.65	21.508301	74.491699	0.080276
34.5	8.5	A.9622	2.90	25.644911	74.351089	0.068001
34.5	8.6	A.9622	2.30	30.279144	69.720856	0.054250
34.5	8.7	A.9622	1.83	35.347470	64.852130	0.050504
34.5	8.8	A.9622	1.45	40.748936	59.231664	0.044352
34.5	8.9	A.9622	1.15	46.428393	53.575687	0.039465
34.5	9.0	A.9622	0.92	52.173353	47.026645	0.035583
34.5	9.1	A.9622	0.73	57.865295	42.134705	0.032499
34.5	9.2	A.9622	0.58	63.355600	36.646394	0.030050
34.5	9.3	A.9622	0.46	68.519730	31.480270	0.028104
34.5	9.4	A.9622	0.36	73.263194	26.736801	0.026559
34.5	9.5	A.9622	0.29	77.526367	22.473633	0.025331
34.5	9.6	A.9622	0.23	81.283447	18.716553	0.024356
34.5	9.7	A.9622	0.18	84.537644	15.462311	0.023581
34.5	9.8	A.9622	0.15	87.314392	12.685688	0.022966
34.5	9.9	A.9622	0.12	89.653519	10.346481	0.022477
34.5	10.0	A.9622	0.09	91.602768	8.397232	0.022089
34.5	10.1	A.9622	0.07	93.212631	6.787369	0.022089

CONCENTRATIONS OF AMMONIA (NH4-NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

TEMP C	pH	pKa	RATIO	% UNIONIZED AMMONIA	% IONIZED AMMONIA	CONCENTRATION NH4+ NH3
35.0	5.0	A.9478	8867.57	0.01127%	99.988724	192.603729
35.0	5.1	A.9478	7043.77	0.01419%	99.985824	145.951758
35.0	5.2	A.9478	5595.07	0.017870	99.982117	115.223022
35.0	5.3	A.9478	4444.31	0.02249%	99.977493	91.529184
35.0	5.4	A.9478	3530.26	0.02831%	99.971680	72.704679
35.0	5.5	A.9478	2404.19	0.03564%	99.964340	57.754420
35.0	5.6	A.9478	1692.33	0.04487%	99.955124	45.883774
35.0	5.7	A.9478	1405.43	0.05647%	99.943512	36.451065
35.0	5.8	A.9478	1116.37	0.07110%	99.928894	28.958374
35.0	5.9	A.9478	886.77	0.08949%	99.910492	23.066729
35.0	6.0	A.9478	704.39	0.11264%	99.887344	18.279144
35.0	6.1	A.9478	559.51	0.14176%	99.858231	14.521505
35.0	6.2	A.9478	444.44	0.17840%	99.821579	11.540997
35.0	6.3	A.9478	353.03	0.22449%	99.775497	9.171593
35.0	6.4	A.9478	280.42	0.28246%	99.717529	7.264493
35.0	6.5	A.9478	222.75	0.35533%	99.644653	5.794492
35.0	6.6	A.9478	176.94	0.44931%	99.553055	4.606972
35.0	6.7	A.9478	140.54	0.54200%	99.457948	3.663688
35.0	6.8	A.9478	111.64	0.67490%	99.325033	2.914404
35.0	6.9	A.9478	88.68	0.84779%	99.152194	2.319236
35.0	7.0	A.9478	70.44	1.11509%	98.884880	1.844472
35.0	7.1	A.9478	55.95	1.34978%	98.650204	1.470942
35.0	7.2	A.9478	44.44	1.75585%	98.244141	1.172646
35.0	7.3	A.9478	35.30	2.20040%	97.799500	0.935702
35.0	7.4	A.9478	28.04	2.75455%	97.245434	0.747490
35.0	7.5	A.9478	22.24	3.44321%	96.556774	0.597484
35.0	7.6	A.9478	17.69	4.29643%	95.703552	0.479234
35.0	7.7	A.9478	14.05	5.34937%	94.650520	0.384505
35.0	7.8	A.9478	11.16	6.62450%	93.357544	0.309976
35.0	7.9	A.9478	8.87	8.22094%	91.774053	0.250458
35.0	8.0	A.9478	7.04	10.13384%	89.866150	0.203181
35.0	8.1	A.9478	5.60	12.43154%	87.564451	0.165427
35.0	8.2	A.9478	4.44	15.16231%	84.837677	0.135797
35.0	8.3	A.9478	3.53	18.36711%	81.632889	0.112103
35.0	8.4	A.9478	2.90	22.07307%	77.926926	0.093281
35.0	8.5	A.9478	2.23	26.24011%	74.713949	0.078331
35.0	8.6	A.9478	1.77	30.94332%	69.016674	0.066455
35.0	8.7	A.9478	1.41	36.104871	63.891124	0.057022
35.0	8.8	A.9478	1.12	41.57159%	58.428409	0.049529
35.0	8.9	A.9478	0.89	47.244603	52.753397	0.043577
35.0	9.0	A.9478	0.70	52.594644	47.405351	0.038449
35.0	9.1	A.9478	0.56	58.571143	41.428857	0.034094
35.0	9.2	A.9478	0.44	64.121552	35.878448	0.031211
35.0	9.3	A.9478	0.35	69.236164	30.769836	0.029741
35.0	9.4	A.9478	0.28	73.907333	26.092657	0.027459
35.0	9.5	A.9478	0.22	78.044440	21.951520	0.026364
35.0	9.6	A.9478	0.18	81.782364	18.217636	0.025177
35.0	9.7	A.9478	0.14	84.945954	15.054042	0.024233
35.0	9.8	A.9478	0.11	87.676941	12.323059	0.023484
35.0	9.9	A.9478	0.09	90.956943	10.043060	0.022889
35.0	10.0	A.9478	0.07	93.854248	6.145752	0.022416
35.0	10.1	A.9478	0.07	93.419327	6.580673	0.022040

** CONCENTRATIONS OF AMMONIA (NH4+ NH3) WHICH CONTAIN AN UN-IONIZED AMMONIA CONCENTRATION OF 0.02 MG/L NH3-N

APPENDIX B

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